Journal of the Society of Arts.

FRIDAY, DECEMBER 17, 1858.

EXHIBITION OF 1861.

The following letter has been addressed to the Foreign Exhibitors in 1851:—

Society for the Encouragement of Arts, Manufactures, and Commerce.
Adelphi, London, W.C., 8th December, 1858.

Sir,—The Council of this Society have had under their consideration the desirableness of holding in London, in the year 1861, another International Exhibition of Industry. The Exhibition of 1851 having originated with this Society, gives it a peculiar claim to interest itself in the promotion of such displays in future. The Council of this Society have passed the resolutions* a copy of which I have the honour to enclose.

Previous to the year 1851, National Exhibitions had been held in other countries, but England was the first to try, in that year, the novel experiment of a great International Exhibition, which is admitted on all hands to have been eminently successful, and to have conferred great benefits on the industrial world at large. The Council believe that the manufacturers of this country are ready to support another Exhibition in 1861; but whilst the Council are employed in considering the best means of carrying it into effect, they are desirous of learning how far they may reckon on the support of foreign contributors.

Although it may be premature at the present time to issue definite invitations to manufacturers and others to exhibit in 1861, yet the plan has so far advanced as to render it desirable that early notice should be at once given to the public, both in foreign countries and at home, of the views and intentions of the Council; and I am directed to ask if the Council may hope to see your name in the list of exhibitors in 1861, as it was in 1851.

I have the honour to be, Sir,
Your obedient servant,
P. LE NEVE FOSTER, Secretary.

FIFTH ORDINARY MEETING.

Wednesday, Dec. 15, 1858.

The Fifth Ordinary Meeting of the One Hundred and Fifth Session, was held on Wednesday, the 15th inst., Admiral Sir Charles Napier, K.C.B., M.P., in the chair.

The following candidates were balloted for and duly elected members of the Society:—

Lye, Charles Frederick | Poncia, Frederick Theodore

The Paper read was—

ON THE MODIFICATIONS WHICH THE SHIPS OF THE ROYAL NAVY HAVE UNDERGONE DURING THE PRESENT CENTURY IN RESPECT OF DIMENSIONS, FORMS, MEANS OF PROPULSION, AND POWERS OF ATTACK AND DEFENCE.

By E. J. Reed.

The science of naval architecture was so greatly advanced on the Continent, and so much neglected in England, during the last century, that the forms, dimensions, and speeds of the ships of the British Navy were, for the most part, inferior, class for class, to those of every other nation with the ships of which we had to cope. The only mode of improvement which the naval authorities of that period countenanced, was that of imitating the forms of such captured vessels as were deemed superior to our own; and, therefore, as "imitation cannot go above its model," the attainment of excellence was not possible. Full advantage was not taken even of the imitative system, imperfect as it was; for, whenever the form of a foreign model of any given class was copied, the dimensions—and therefore the power of carrying weight and sail—were invariably reduced, and many of the best qualities of the vessel thus sacrificed. Throughout all the wars waged by England during the eighteenth century—with France, Spain, Holland, and America—the genius of our admirals had continually to struggle with the great evil of overburdened ships. Whenever a British man-of-war fell into the hands of the enemy, her armament was forthwith diminished, and her efficiency thus improved, as was frequently discovered on the recapture of our own ships. The evil was, however, but little regarded by successive naval administrations, and prevailed even to the end of Lord Nelson's career, diminishing the extent, though not the splendour, of those victories with which he glorified the dawn of the present century. Happily for us, and for those colonies and states whose liberties depend upon our naval supremacy, the tactics of our admirals, and the bravery of our men, won for us much more than we lost by the inferiority of our vessels. Happily, also, that inferiority no longer exists. The ships of our navy have not only ceased to be imitations, but have become the models for the navies of the world, and I have now to trace the progress of the great changes which they have undergone—changes which embrace not minor variations merely, but entire and unprecedented transformations, consequent mainly upon the introduction of steam. In doing this, I shall not enter into those details of practical construction which concern the shipbuilder only, and not the commander, my object being to record those modifications of dimensions, forms, means of propulsion, and powers of attack and defence, upon which the value of our ships as engines of war more immediately depends.

It has already been stated that our vessels of war were much inferior in size fifty years ago to the vessels of foreign navies carrying like armaments. In the war which the United States declared against us in 1812, our inferiority was disastrously demonstrated. The large frigates with which the Americans assailed our fleets stationed on their coast, were too powerful to be successfully resisted. For their superiority was not confined to size alone; their armaments likewise greatly exceeded ours in vessels nominally of the same class, the English ships carrying many light carronades that counted as cannon, and the American being sometimes armed with guns 50 per cent. greater in number than they were supposed to bear. The result was that many a British flag was struck after a hard-fought battle, and the star of our supremacy, which had burned so brilliantly since the days of Blake and the admirals of the Commonwealth, seemed to sink in the western waters. This fact so far stirred our naval authorities as to induce them to build new vessels of uncommon size, and to razée, or cut down, several two-decked ships and arm them as large class frigates. Even then, however, the vicious practice of keeping the dimensions of our vessels below those of their antagonists was by no means rooted out. On the contrary, the American cruisers were permitted to retain an unquestionable superiority in their sailing powers, their armaments, and the numbers of their crews. Then, however, as before—and may I not say since?—the mistakes of our administrators were atoned for by the courage of our men; and Captain Broke and his gallant companions in the *Shannon* captured the formidable *Chesapeake*, and restored our national prestige.

* See *Journal*, Vol. VI., p. 333.

When the conclusion of the wars with America and France, and the successful expedition to Algiers, had left us without notable enemies, leisure was afforded for the consideration of such improvements as experience had shown to be desirable. Sir Robert Seppings, the Surveyor of the Navy, and the introducer of several important improvements in the frames and other portions of the fabrics of ships of war, effected great changes in their bows and sterns. After the Battle of Trafalgar, the *Victory* was repaired at Chatham Dockyard, of which Sir Robert was then master shipwright; and in surveying her he observed that she had suffered much on the upper or main deck, when bearing down on the enemy at the commencement of the action, in consequence of the grape shot penetrating the thin transverse beak-head partition then in fashion, which was without the ordinary timbering. It was perfectly evident, he said, that had the ship been formed with a regular and solidly-built bow, many a life would have been saved. This was fully acknowledged by Captain Hardy, and after a short period the strong circular or curved bow now in use, which is framed and planked like the rest of the ship, was introduced. This bow is attended by additional advantages—including the use of bow guns, an increase of strength, and others which I cannot stay to mention. Sir Robert contended, I believe, that he was the first inventor of round bows. But that famous old ship, the *Royal Sovereign*, which Charles I. built with his fatal ship-money, and which Cromwell so vigorously availed himself of, notwithstanding her origin, undoubtedly had a round bow, as an ancient drawing now in the model room of Somerset House plainly evidences. This fact, however, in no way detracts from the great merit of Sir Robert's improvements.

Sir Robert next turned his attention to the sterns of vessels; and here he considered a similar change necessary, to improve the defence of the vessel, to increase her strength, and to enable her to fight her stern guns with greater advantage. It was objected by some opponents of Sir Robert that the evils he believed to exist were not real—that sterns were not weak—that their fighting capabilities did not need improvement—that we had no need of stern guns in our navy at all, as we always fought and never ran—and that by improving our sterns we should only be teaching our enemies, who did run, how to arm theirs. All these objections were repeated in 1828, by the gallant admiral, Sir Charles Napier, in a letter addressed by him to the *Naval and Military Gazette*, and signed "A Post Captain." It is difficult, however, to admit the validity of such statements. I consider the whole of them more than answered in an able letter, addressed by Sir Robert Seppings in 1822, to Viscount Melville, the First Lord of the Admiralty. Sir Robert there states facts which the most dashing Napierian sentences cannot destroy. The circular sterns were, however, undoubtedly attended by one great fault, which Sir Charles Napier pointed out in the following paragraph of the letter just referred to:—"In the first place," he says, "the rudder is too much exposed. In the second place, the ship is deprived of her counter, which I have always considered a very necessary part of her, and which one would suppose the very derivation of the word from the French word *contre* sufficiently proves the utility of. I apprehend without that projection the sea would come in at the cabin windows; and, lastly, the whole of the gingerbread outside of the ship would be blown away when the guns were much used." The first of these objections is, doubtless, perfectly valid, and the last not without reason. The second however is not well founded. It is not possible that the use of a certain word by the French can "prove" the utility of a ship's counter. It may indicate the opinion of the French upon the point, but it can do no more. Further, it is evident that the low projecting counter of a ship may receive shocks from waves which would never climb to the cabin windows. The round stern was, however, attended by another defect, which, together with the exposure of the rudder, led to its abandonment, and to the adoption of its main features in a modified form. This defect was the heavy and ungraceful appearance which all agree in attributing to it. The attainment of beauty is not certainly the primary object in the construction of vessels of war, nor can the aim of their designers be that of gratifying the exquisite taste of the poet laureate, as from his Isle of Wight residence he sees

> "Below the milky steep
> Some ship of battle slowly creep,
> And on thro' zones of light and shadow
> Glimmer away to the lonely deep."

On the contrary, if there were on earth any object in which an utter want of beauty might be deemed tolerable, it would be, I presume, a ship of war—a thing conceived and built for battle, filled with compact fires, and commissioned to thunder forth deadly destinies. But beauty is never unbecoming; we look for it even in a war-ship, and the elliptical stern which has succeeded the circular stern, eminently possesses it. The design of this stern, which permitted the builder to afford increased protection to the stern-post, and which is now adopted in all new ships of war, was claimed by each of three late master shipwrights—Mr. Lang, Mr. Blake. and Mr. Roberts. It was introduced under the auspices of Sir W. Symonds, and in the form which is now given to it by Sir Baldwin Walker, the present Surveyor of the Navy, is a truly admirable combination of beauty and utility. The principal curves visible in it harmonize so well with the sheer lines of the ship, that she appears to float lightly and easily upon the water, whereas the circular Seppings' stern, with its obtrusive stern post, made the spectator feel not only that much of the ship was submerged, as it in fact was, but also that the submersion of the whole of her was imminent. There is of course no power in the ugliest vessel to sink deeper than the laws of hydrostatics will allow her; but it is not pleasant to have to correct an impression of art by reference to a fact of science.

It was intended that with the improved bows and sterns the foreward and the right aft guns might be fired in the direction of the keel—that is, be brought to bear upon an enemy immediately in front or rear of the ship, and that the fires of every two adjacent guns from bow to stern might cross each other within easy range, so that the ship should have the power of defending herself, and of attacking an enemy in every direction with two guns at least. Great difficulty was, however, often experienced in getting the bow chase guns to run out far enough to prevent injury to the ship on the discharge of the gun, for it is by no means an easy matter to make a vessel sufficiently bluff for that purpose on the deck line, and at the same time to keep her fine at the load water line. This difficulty has recently been evaded by the adoption of a pivot gun raised above the fixed bow of the vessel, and capable of being turned upon shifting centres at one end, and of running on circular or segmental plates at the other. This gun commands the entire sweep of the bow, and, being usually of large calibre and long range, is admirably adapted for chasing. Its introduction into the service was a very notable improvement. The pivot gun is usually a 68-pounder, sometimes a 10-inch shell gun; and it is fitted in all our first rate steam line-of-battle ships, and most other steam ships of war, including second and third rates, frigates, corvettes, and many scores of our steam gun boats. In several classes of ships a second pivot gun, of like size, is fitted at the stern. All our steam block ships are thus fitted, as are also the whole of our screw steam gun vessels, numbering, according to the current number of the "Navy List," twenty-six. It is difficult to believe, however, that we are acting wisely in accepting the bow pivot gun as a sufficient substitute for the bow chase guns on the fighting decks of our screw

line-of-battle ships, as I observe we have done in some modern examples. The pivot gun is an exposed gun, and is liable to be disabled in action; it cannot therefore be prudent to depend, in a large ship, upon it alone for our power in chasing, and to deprive ourselves of the means of firing a single shot directly in advance, should that one gun be injured. I am fully aware that by running this risk, fine lines may be given to the vessel, but this advantage is not worth the risk, as I fear we shall prove in the event of a naval war if we pursue the new system.

Still more interesting changes were introduced by the successor of Sir Robert Seppings, at which I have now to glance. In the year 1819, Lieutenant William Symonds, an officer of 25 years' standing in the service, was appointed Intendant of Marine Police, and captain of the Port of Malta, and, being of an inventive turn of mind, there took to yacht building. For the knowledge of this fact I am indebted to a poem of his, in which he says,—

> "In Malta I first took to naval construction,
> In Malta I launched forth my maiden production."

I have elsewhere sketched the progress of Lieutenant Symonds from this period of his career as briefly as I was able, and I request permission to repeat here what I there wrote. "His maiden production was the *Nancy Dawson*, and he tells us that 'When the Hon. G. Vernon and his lady came to the island for her health, in their yacht, the *Transit*, I was introduced to them by more than one person, and we soon became very well acquainted. I made my first trial of the *Nancy Dawson's* sailing against his yacht, and had so considerable advantage that I was led to believe that I had hit upon a secret in naval architecture; and after trying my hand upon four or five others of a smaller description, which answered beyond my warmest expectations, I was confirmed in the success of my principles by these experiments. Great breadth of beam and extraordinary sharpness' (—sharpness of what?) 'are the characteristic features of my system, with a careful attention to stowage, the stand of the masts, and the cut and setting of the sails; nor had I, in any instance, occasion to alter anything materially from my first idea. The consequence was, a firm conviction that I might attempt something on a larger scale, with every hope of success.' Upon this most slender basis was the whole fabric of Sir William's subsequent career built. The yacht gained him the notice of noblemen and others; then followed a pamphlet on naval architecture (in which the defects of many existing ships were pointed out, and great breadth of beam and rise of floor were advocated); then came a promise from the First Lord of the Admiralty, Lord Melville (obtained through the influence of Lord Lauderdale), that he should build a sloop of war on his plans, which he did, the vessel being called the *Columbine* (promotion intervening;) then further patronage from the Duke of Portland, and the Duke of Clarence, the latter of whom, when he became Lord High admiral, ordered him to lay down a 40-gun frigate (promotion again intervening); then the building of the *Pantaloon*, 10-gun brig, for the Duke of Portland, from whom the Admiralty purchased her; then the patronage of that most mischievous civilian First Lord, Sir J. Graham; then the order for the *Vernon*, 50-gun frigate; and then, in 1832, the Surveyorship of the Navy!" *

The characteristic features of Sir William's designs for ships were, as we have seen, great breadth of beam at and above the water line, and great sharpness of floor.

I have not space here to discuss the merits and demerits of the characteristic qualities of the ships of Sir William Symonds, or to revive the prolonged and bitter controversies to which his elevation gave rise. Sir William was essentially an amateur ship-builder, and the Lords of the Admiralty (influenced mainly by Sir James Graham) by investing him with supreme control of the Surveyor of the Navy's department, made war not only upon professional naval architects, but upon the profession of naval architecture itself. The consequence was that ship-building officers, both of the old tentative school and of the new scientific school, which latter had lately been called into existence by their lordships, strenuously resisted Sir William's innovations; but as he was supported by powerful friends, and had a large amount of patronage in his own hands, while his opponents were, almost without exception, his subordinates, I need not say who for the time triumphed. It should be observed, however, that the principles of construction for which Messrs. Read, Chatfield, Creuze, and others trained in the school of naval architecture contended, are to a great extent predominant at the present day in the Royal service, while not a single feature of Sir William Symonds' system of construction is retained,* except certain practical improvements which he made in the actual building of ships, and which deserve to be mentioned with the utmost favour. Still his services as a naval constructor were not without value to the country. He was the first who proved successful in breaking down and abolishing that vicious system of restricting constructors to certain arbitrary dimensions to which I have before referred, and in which the Admiralty persisted until his time. This was no small service. He also brought into his department an energy which filled it with vigour, and prepared the way for those sound and scientific changes which his more temperate successor has promoted with equal zeal and superior judgment.

Had Sir W. Symonds lived a century earlier, his career might have closed in brightness and triumph; but, coming when he came, he had scarcely raised himself to his high office before he began to feel his schemes and crotchets baffled by a power whose marvellous progress no devices of man can withstand. The all-changing irresistible power of steam, against the mastery of which so many have vainly mutinied, began to make itself felt in the Royal Navy even before Sir William commenced experimenting at Malta. In 1815, Lord Melville ordered an engine to be built for the sloop of war *Congo*, and, although that vessel was not fitted with it, the design of propelling ships of war by steam was not abandoned. In 1821, the *Monkey*—a vessel which is still, I believe, doing duty at Woolwich—was purchased by the Admiralty, and her name is likely to become memorable as that of the first steamer the Royal Navy possessed. Her purchase was followed by the building of the *Comet* at Deptford dockyard, under the direction of the late Oliver Lang, Esq. Other vessels succeeded rapidly, some designed by Sir Robert Seppings, others by the master shipwrights of the dockyards, and others by private builders. All were, of course, for many years fitted with paddle wheels. Ultimately, in the year 1832, Sir William Symonds had

* *Mechanics Magazine.* Vol. 68, No. 1812, p. 413.

* As an example I may refer to the forms of midship section advocated respectively by him and by them. Sir William's great principle—or rather Sir William's great crotchet—was he sharpening the floor of the ship, at the same time carrying her greatest breadth considerably above the load-water line. The latter he deemed essential to stability. The members of the School of Naval Architecture, on the contrary, pointed out that, by making her sharp of floor, and broader above the water-line than at it, the ship, when inclined by the wind, by tending to immerse more of herself on one side than emerged on the other, would be moved bodily upwards, and thus subjected to vertical motions, more or less violent, which would tend to the injury of her fabric and the discomfort of her officers and men. They, therefore, recommended that the midship sortion of the side of the ship should be either vertical, or pimilarly inclined immediately above and below the water-line, and considered that nothing better than a side vertical between wind and water could be chosen for a ship of war. I have only to add, on this point, that all new ships of war now have the full floors and vertical sides which they recommended. Thus, on two points of the very first importance, Sir William's ideas have been discredited, and the same may be said, with equal truth, in respect to his third doctrine—that of the necessity of giving great depth of beam in proportion to length. The proportion is less now than ever. E. J. R.

the designing of steam, as well as all other vessels for H.M. Service, committed to him as Surveyor of the Navy.

Nothing more unpropitious for Sir William's mode of construction than the introduction of steam can be conceived. His sharp bottoms were the very worst possible for the reception of engines; his broad beam and short length the most unfavourable qualities that could be devised for steam propulsion. As much as he could he adhered to his principles, and, although compelled by sheer necessity to adopt an increase of length and a greater fullness below water, he changed his plans as little as possible. Rather than yield to the demands of the new power, he sacrificed the armaments of his vessels, kept down the size of their engines, and recklessly exposed the machinery to shot should they go into action. To his lasting honour, Sir Charles Napier exposed and fought earnestly against these great evils; not with any immediate success, it is true, but the introduction of steamers with guns upon the main deck was mainly the result of his just, persistant, and courageous denunciations of the system under which the expense of large vessels and costly engines was incurred with no better result than that of bearing half-a-dozen guns about.

In the year 1837, Captain Ericsson made a very favourable run down the Thames in a steam vessel fitted with his patent screw propeller, having the Lords of the Admiralty and Sir. W. Symonds on board. Notwithstanding the success of the experiment, and the manifest advantages of a submerged propeller for a ship of war, Sir William made no sign in favour of the new instrument. Captain Ericsson, therefore, took it to the United States, where it was speedily introduced into the war navy of America. Three years afterwards, in 1840, the *Archimedes*, fitted with Mr. Smith's patent screw propeller, made many highly successful trial trips, which were reported to the Admiralty by officers of their own. After further opposition and a further delay of years, the *Rattler*, a ship of war, was adapted at Sheerness to receive a screw propeller, and after numerous experiments with screws of different forms, the two-bladed screw now exhibited at the Patent Museum, South Kensington, was finally adopted as the best that could be devised. In 1845, the *Rattler* was tested in comparison with the *Alecto*, a paddle-wheel vessel of similar form, size, and steam-power, and the test still further established the superiority of the screw. The *Rattler* was by chance built with a particularly fine run aft; but as this was not known to be essential, other screw steamers were commenced with a greater fullness near the stern. The access of the water to the propeller would thus have been seriously interfered with, but Mr. Lloyd, now the chief engineer and inspector of machinery in the steam branch of the Surveyor of the Navy's office, very wisely foresaw the evil, and induced the Admiralty to take the necessary steps for its prevention. Since 1846, the building of screw ships has become so general, that not only has the paddle-wheel been altogether superseded in all newly-built fighting vessels, but there is not even a single ship unprovided with a screw now on the stocks. Every ship now built is fitted with that steam-driven submerged propeller, the introduction of which, the late surveyor of our navy, only 11 years since, was obstinately resisting, and had obstinately resisted for 11 years previous. Surely the policy of placing it in the power of one prejudiced man to prohibit the nation for many years from rendering its greatest scientific achievement available in its own defence, when other nations were extensively adopting it, is deserving of nothing but unmitigated reprobation.

Admiral Sir Charles Napier, to whom I have had occasion already to make frequent reference, was among the very first to apply iron as a material for constructing steam-vessels. With Sir Charles Napier was associated Mr. Charles Manby, the much respected secretary of a contemporary professional institution. Together these gentlemen formed a society, and built the first iron steam vessel, the *Aaron Manby*, which Sir Charles took charge of, and navigated to Paris. Other vessels followed; but for their history I must refer you to Mr. Grantham's admirable volume on "Iron Shipbuilding," in which their progress is traced from the earliest example up to that magnificent vessel to which the London public are now thronging, and which, by her excellence of design and her strength of structure, even more than by her immense magnitude, excites the astonishment and admiration of all intelligent beholders.

In 1842 Mr. Belmano, of New York, addressed a letter to the Earl of Aberdeen, alleging that plates of iron $\frac{3}{8}$ths of an inch thick had been rivetted together to a thickness of six inches, and then found to be ball-proof. Sir Thomas Hasting, of H.M. gunnery ship *Excellent*, was instructed to discover if they were so. After making the experiment, he reported that such a combination of plates fixed over the planking of a ship's side would give no protection at two hundred yards against shot fired with 10lbs. charges of powder from 8 inch guns and heavy 32-pounders.

In 1843, however, the Admiralty commenced building iron ships of war, and in three years built and purchased 18 such vessels (besides several others not intended to carry armament), at a cost of £420,000, and £260,000 additional for engines—in all about £680,000. I can offer no reason for this sudden and unexpected movement, which, as I hardly need say, ended in failure. It may have been the result of a well-meant, but ill-advised, attempt to give a rapid expansion to the power of the Royal Navy, or it may have been due to the secret influences brought to bear on some member or members of the Board of Amiralty by interested parties. But of that ingenious and complicated system of wheels within wheels by which our public departments are often worked, I cannot presume to speak. Like millions of others, I know but little save of that one great wheel, the outermost of all, which rolls perpetually along the land, whose revolutions never cease, and from whose path but few escape—the colossal and ponderous wheel of national taxation. Of the wheels within, which move *that*, who has any just or adequate knowledge?

In the construction of mercantile vessels iron is superior to wood. Iron ships, as compared with wooden, may be built lighter and stronger, of greater capacity, of superior speed, increased durability, and at a less cost both for purchase and repairs. In Great Britain, moreover, iron is much more abundant than wood, and its manufacture is now becoming improved almost daily. On the other hand, the bottoms of iron ships get rapidly foul, and their hulls, when of moderate thickness, are shattered by the action of shot much more injuriously than the hulls of wooden ships. The first objection is got rid of in merchant vessels, by cleaning their bottoms when they come into port, which they frequently do. The second is, of course, not directly applicable to them. But the rapid fouling of the bottom of a vessel of war, which is often engaged for years together far from all facilities for cleaning her below water, would, at all times, be a highly injurious, and often a fatal evil. The destructive action of shot upon such a vessel, is a still more decided ground of inefficiency. These facts were not considered by the Admiralty in 1843, and when Sir Charles Napier mentioned in the House of Commons the folly of building five or six iron steamers without trying one, the Secretary of the Admiralty exultingly exclaimed, Sir Charles informs us, "We are building forty." They did build, not forty, but eighteen, at a cost, as I have said, of considerably more than half a million.

Experiments were made at Woolwich Arsenal to test whether, if iron were lined with kamptulicon—a mixture of India-rubber, cork, &c.—the holes formed in the fabric by the shot would not be stopped after the shot's passage, by the closing up of the elastic substance. Some advantage was gained in this way, but not sufficient to lead to the adoption of such a combination. In 1846,

the *Ruby*, a small vessel, built of thin iron, and in a bad state of repair, was fired at from the *Excellent*, and Captain (now Admiral) Chads, reported that the shot passed clean through the near side of the vessel, but that on the off side the effect was terrific, tearing off the sheets of iron to a very considerable extent. Splinters from the near side were few but severe. These conditions were reversed by subsequent experiments made by Admiral Chads, the near side being found to suffer most in stronger vessels. In July, 1850, after numerous experiments, he finally reported that iron could not be beneficially employed as a material for the construction of vessels of war. Since that time the building of iron ships of war has not been proceeded with.

I come now to the period of the late war with Russia, which, though a military rather than a naval contest, did not fail to exert important influences upon the constitution of the Royal Navy. That war opened, it will be remembered by a Russian attack on a Turkish squadron at Sinope, November 20th, 1853, at a time when Russia had bound itself by a solemn promise to act on the defensive only. The Turkish squadron consisted of 7 frigates, 1 sloop, 2 corvettes, 2 steamers, and 2 transports, supported by five land batteries. The attacking squadron was composed of 6 line-of-battle ships, and 2 frigates, supported by three or four steamers. The latter squadron was well supplied with shell guns, while the Turks had nothing more effective than 24-pounders. The action was speedily decided, by the burning of almost the whole of the Turkish vessels, produced, as the surviving officers stated, exclusively by the shells of the enemy. The only frigate that remained afloat after the action, the *Damietta*, had seventeen shots through her below water, and was therefore burnt. I mention this engagement merely as an early and notable example of the destructive effect of shell guns in naval warfare, the remarkable circumstance being, not that the Turks were beaten—for the Russian force was vastly superior to theirs—but that their whole force of fourteen ships was, to a great extent, silenced in a few minutes, and utterly crushed in little more than an hour.

It has been fashionable, in some quarters, to sneer at the operations of the combined navies of England and France in the Black and the Baltic Seas during the war; but the spectacle of one Russian fleet sunk by Russian hands at Sebastopol, and of another trembling, season after season, behind stone fortresses in the shallow waters of Cronstadt, never daring to accept the challenge of any British squadron, however small, is one the record of which we certainly may read without shame. Still, the fleets of England, though well adapted for battles by sea, and sufficient to drive the enemy from the open waters, were almost totally deficient of the class of vessels which were essential to the putting forth of our full power against his fleets and coasts. Nor was the want supplied with anything like that promptitude which the occasion demanded. It is difficult, with all the facts before us, to believe that the neglect occurred in the naval department. The Government, it will be recollected, was inactive; slow not only in entering upon war—which all governments should be; but slow also in conducting the war after it was entered upon—which no government should be. When they grew vigilant and active, and the Naval Department was called upon to provide light-draught steam vessels without delay, the work was entered upon with astonishing and admirable rapidity. All the capabilities of the royal dockyards were put into instant requisition; the Government steam factories were everywhere expanded, and in some places, such as Sheerness, created; and private builders were called upon to take up large contracts. The execution of these contracts, though performed with the utmost alacrity and good-will, involved the contractors in serious pecuniary losses, which the Survey or of the Navy exerted himself to mitigate, and did mitigate to some extent. This evil was, I grieve to say, greatly aggravated, if not altogether occasioned, by the excessive demands for wages made upon the contractors by their workmen, who knew they were needed, and straightway played the tyrant. As a correspondent of mine truly wrote some months since, "The reminiscence of the Russian war, to those who built the gun-boats, is an exceedingly painful one. Ruin befel one or two of those builders, and all sustained heavy pecuniary loss. The only relieving light it has, is the indelible impression which the urbanity and sympathy of Sir Baldwin Walker evinced, and the appropriateness and beauty of form of the vessels which his immediate assistants designed." The last sentence implies a fact which some have doubted. The "appropriateness and beauty of form" of the new gun-boats, gun-vessels, and despatch vessels have been questioned. No one, however, who has seen the corresponding vessels, built by the French, and who understands *all* the difficulties of combining speed, lightness, sea-worthiness, and a powerful armament in one vessel, will question them. Mr. Scott Russell's paddle-wheel gun vessels, the *Recruit* and *Weser* (formerly the *Nix* and *Salamander*), are in many respects most excellent vessels, and the former proved very valuable in the Sea of Azof. Captain Dahlgren, of the American Navy, mentions her as "highly spoken of, being a fast and an excellent sea-boat;" but the same experienced officer says also of the Admiralty's vessels, "For the service contemplated, this fleet of small screw-vessels was well adapted—far better than any other." Further, Sir Howard Douglas, Bart., the distinguished author of "Naval Gunnery"—to whom the naval service is more indebted than to any other man living or dead for the efficient use of its armaments—published only a fortnight since a treatise on "Naval Warfare," in which, while he complains of the great length of the despatch vessels as a cause of weakness, he adds, "A smaller class of steam-vessels has since been constructed as gun-boats, and these come fully up to the author's idea of what a good gun-boat should be." They possess, however, one great defect in the rapidity with which the tube-plates of their boilers burn out. So great is this evil in the gun-boats, that in the mere trials of the engines the boilers often become so bad as to require extensive repairs.*

The Admiralty have frequently been accused of building line-of-battle ships in profusion, to the neglect of frigates and lighter vessels. If there was some show of reason in this charge at the commencement of the Russian war, since that period there has existed no ground for its repetition. Our

* I have great pleasure in being able to state that Rear Admiral J. Jervis Tucker, and Mr. Blaxland, Superintendent Engineer of the factory at Sheerness Dockyard, have energetically endeavoured to remedy this evil, and have succeeded in getting rid of the troublesome and expensive tubular system altogether. They simply employ a series of several fire-clay bridges within the furnace, in conjunction with means for admitting air, at the same time diminishing the size and increasing the number of the fire places. The system answers perfectly, and not only does away with the derangements and expenses attendant upon the tubular system, but also increases the evaporation, prevents the formation of smoke, greatly economises the fuel (a very important point in marine boilers), and renders the supply of steam to the engine surprisingly uniform. Some delay has occurred in the adoption of these improvements by the Steam Department of the Admiralty, mainly, I believe, in consequence of Captain Halsted and the engineers of the steam reserve at Sheerness having instituted experiments with a modified form of tubular boiler, which appears to me to be either the same as, or a very slight variation of the boiler patented by Mr. Bartholomew, in 1856. It is difficult to believe that there can be any partiality on the part of the Steam Department of the Admiralty to tubular boilers, the defects of which have been so fully explained by this Society's distinguished prizeman, Mr. Charles Wye Williams, and I am happy to hear that the Admiralty contemplate having a gun boat or two fitted for trial with the ipmrovements of Admiral Tucker and Mr. Blaxland.—E. J. P

navy is now composed of the following fighting vessels:—First, 201 sailing vessels of all classes, but few of which, probably, will ever again be commissioned. (Might not some of these be sold with advantage? Scores of them, which will not be used again as ships of war, would be valuable for many mercantile purposes, and should not, therefore, be permitted to rot in our harbours.) Next, we have 75 paddle-wheel steamers, most of which, though not very effective for fighting purposess will, while they last, be of considerable value in times, of peace, and of some service even in war. Finally, we have a fleet of screw steam-ships and vessels, to the constitution of which I desire to draw particular attention. It consists of 51 line-of-battle ships, each armed with 8-inch shell guns and 32-pounder solid shot guns, in various proportions, together with one, and in some cases two, pivot 68-pounders; 9 block ships, also armed with 8-inch shell-guns, and 32-pounders in various proportions, together with two 68-pounders, and four 10-inch shell-guns to each ship; 28 frigates, most of them powerfully and some them very formidably armed —the engines of 16 of the 28 being at least of 600 nominal horse-power; 13 corvettes, each carrying twenty 8-inch shell-guns, and at least one 68-pounder, or one 10-inch shell-gun; 8 other corvettes, armed with 32-pounders, and at least one pivot-gun each; 4 mortar frigates, with 13-inch mortars, 68-pounders, and 32-pounders; 8 floating batteries, entirely with 68-pounders; 27 sloops, mainly with 32-pounders; 26 gun-vessels, with 68-pounders and 32-pounders; and 163 gun-boats, each with one 68-pounder and one 32-pounder—in all 331, inclusive of a few now building and undergoing alterations. It is impossible to examine these figures without observing that the number of our frigates, corvettes, sloops, and still smaller vessels, is very large as compared with our ships of the line; and it is, in my judgment, equally impossible to point out any very glaring defects in the principle upon which they are armed. This latter statement cannot well be tested otherwise than by a comparative reference to foreign navies. The only two of these to which I need refer are those of France and America. As to the former, I have carefully examined the official records (which are published by Sir Howard Douglas in his Naval Gnnnery), and I find no ground whatever for considering that the armaments of French ships of war are in any way superior to our own. With regard to the American navy we have, indeed, heard much that sounds formidable, recently, especially of the *Niagara* and the *Merrimac*. Of the former of those vessels I need say but little, as the American Government itself places small confidence in her. She is, it is true, a gigantic vessel, but she carries only a dozen shell-guns; and our own frigate, *Diadem*, of about two-thirds her size, would, as I have elsewhere shown, speedily overpower her, either at short or at long range. The *Merrimac* is certainly a very formidable vessel. Captain Dahlgren, in a recently published work on "Shells and Shell Guns," draws a careful comparison between her and our own *Shannon*, the name of which will be fresh in every mind, as the last command of the chivalrous and much lamented Sir William Peel. Captain Dahlgren very fairly decides that the *Merrimac* is the more powerful ship of the two; but seeing that, as he admits, her tonnage is one-fifth greater than the *Shannon's*, we might well be astonished if she were not of superior power. We have, however, other vessels similar in size to the *Merrimac*, one class of which is armed entirely with heavy 68-pounders, from which, of course, eight-inch shells can be most effectively fired; and another class armed with a combination of ten-inch shell-guns and 68-pounders of 95 cwt. The vessels of both these classes are fitted with engines of no less than 1,000-horse power, by virtue of which they will probably attain a speed of twelve or fourteen knots per hour, while the *Merrimac* makes eight knots only. The advantages of this superiority of speed I need not dwell upon. Captain Dahlgren has himself since said, in reference to these vessels, "there can be little doubt that with any reasonable success in applying their capabilities they must become the most formidable of ships of war."

Although I have thus pointed ont the efficiency of our ships as compared with those of France and America, I by no means wish to to imply that the armaments of our steam fleets are not susceptible of improvement with the means already at our disposal. The very variety observable in the armaments of ships of similar dimensions indicates imperfection, and even evinces a sense of imperfection in the minds of the authorities who arrange them. Moreover, Sir Howard Douglas and Captain Dahlgren have particularised one class of gun which is much used by us, but which is too light for its duty, viz. the 10-inch shell-gun of 86 cwt. This gun has been superseded in the American navy, by one of 107 cwt., and should certainly occupy a less prominent position in ours. Other desirable modifications might, doubtless, be made, and the whole subject requires still deeper study than appears to have been bestowed upon it. It is, however, far too broad for any complete discussion of it to be here attempted.

Before passing to topics of a novel character, it should be stated, however summarily, that, in respect to those great features to which I have this evening to refer, viz., dimensions, forms, means of propulsion, and powers of attack and defence, the ships of our navy have become, during the surveyorship of Sir Baldwin Walker, the embodiments of all such sound and well-tested improvements as have been hitherto found compatible with the purposes for which ships of war are designed. This is a very broad statement, and one which I should not venture to make on my own responsibility only, lest I should seem to offer a compliment, which, coming from a private individual, would at least be valueless. But, as the present Surveyor of the Navy is so often commended in Parliament, by officers of the greatest judgment and experience, I do not hesitate to speak of the facts as I find them. I may state, then, first that the dimensions of our ships are increased, as necessity seems to require, without any kind of prejudice. We have 50-gun frigates of nearly one-fourth greater tonnage than the largest line-of-battle ships of fifty years ago. Then the tonnage averaged in large ships about 25 tons per gun; now it averages in our frigates 50 tons per gun; it is true that this difference partly arises from the introduction of the engines and fuel, but it is also greatly due to a wise increase in the carrying power of the ship, independent of her steaming requisites; again, the forms of our present ships have been adapted, by the introduction of fine water lines, to the circumstances attendant on screw propulsion, so as to ensure the high speeds for which our navy has lately become remarkable. Sir Howard Douglas, in his treatise on "Naval Warfare," refers this quality partially "to the adoption of the *wave principle* in forming the bows." This, however, is a mistaken though a very pardonable supposition. Mr. Scott Russell's wave-line theory, which, whether right in all or in some only, of its features, has been the occasion of vast improvements in ship construction, is not, I believe, adopted by the Admiralty. Many of their ships have, it is true, some water lines which are hollow; but this has arisen not from any admiration for hollow water-lines as such, but from the necessity of combining a convex bow above the load-water-line with fineness and straightness of form at that line, which cannot well be done without giving a slight degree of concavity to the bow below. The extent to which the present surveyor has adopted the screw propeller has already been mentioned; and it may be here added that most of the engines fitted to the steam-ships of our navy are among the finest specimens of marine engineering. The remarks I have already made on the armaments, and those I have presently to make on the armour defences of our modern war-ships, will be seen, on the whole, to give

completenesss to that favourable opinion which I am here expressing. All this does not, of course, imply the absence of minor defects, but it does indicate that the present surveyor of the navy, with the able and well-trained scientific assistants, has not been slow to adopt changes when associated with improvement.

I have now to consider the exceptional vessels denominated floating batteries. The first I shall mention is the *Spanker*, which was designed about the year 1800, by Mr. Richard White, and of which Mr. Fincham, in his "History of Naval Architecture," gives the following account: "This vessel was intended to be a formidable floating battery, to carry guns of large calibre and mortars, so as to be suited for offensive operations in bombardment as well as for the defence of harbours. She was on the deck, 114 feet 6 inches; 42 feet 4 inches in breadth The main deck was of an oblong shape, and square across at the bow and stern, so that four guns might be fired in lines parallel to the keel. This deck was made to project beyond the bottom, and was intended to be sufficiently high above the water that when boats should go alongside to board, they might be drawn under the projection in which scuttles were formed to fire through into them; but the ship had not enough displacement, and the projection was therefore brought too near the water for the boats to go beneath it. Under sail this vessel was unmanageable: hence she was soon kept for harbour service alone, at Sheerness."

No floating battery was again undertaken in England until the late war with Russia, when the Emperor Napoleon commenced the building of several of these vessels, propelled by steam, and protected over their whole assailable surface with thick armour plates of iron. The original conception of iron-plated vessels has been generally attributed to the Emperor; but he was by no means the first proposer of them. In the second volume of the "Mechanics' Magazine," published in 1824, was an article in which notice was taken of a memoir written by a M. de Montgery, a Captain in the French Navy, in the following terms: — "M. de Montgery contends, that while we have vessels of war constructed of wood, they should at least be plated with iron. Long before any one had thought of substituting metal for wood in the construction of large vessels, plates of iron or brass had been used for covering ships of war and battering rams. The celebrated galley built by Archytus and Archimedes, for Hiero, tyrant of Syracuse, was cased in this way. Philo of Byzantium afterwards proposed using battering machines made entirely of metal; but Father Mersenne appears to have been the first who thought of adopting them for ships. M. Montgery, says, that to render the sides of a vessel shot and shell proof, they should have a plating of iron about six inches thick; that is, a series of sheets of iron with blocks of cast iron between." The proposal to use plates of iron on the sides of ships was likewise made many years ago by General Paixhans, in his "Nouvelle Force Maritime."

The Emperor Napoleon having undertaken the construction of such vesssels, and the English press having become apprized of the fact, a similar undertaking was, to a certain extent, forced upon the Admiralty, and the eight remarkable structures which now exist in our harbours are the result. It cannot be denied that these vessels were prematurely built, or that they are in many respects inefficient as ships of war. In the 4th edition of his "Naval Gunnery," published in 1855, Sir Howard Douglas stated several very cogent facts bearing upon the construction of these craft. To one passage in particular I would refer: "Nor will iron slabs, 4½ inches thick," he said, "be proof against 68-pounder or 84-pounder solid shot, with which it appears the Russians are plentifully provided; and unless the timbers of these vessels are enormously thick, such heavy shots will not only punch holes in the iron, but may also make great breaches in their sides by their prodigious power." In confirmation of these observations, I may state that some of the worst effects stated to have been produced by the late gun-practice at Portsmouth upon the *Meteor* and *Erebus* floating batteries, were consequent upon the yielding of the timbers, or of the ribs, rather than upon the penetrability of the plates. I cannot speak with absolute certainty upon this point, because, as the experiments were of great public interest, the Lords of the Admiralty were most careful to have the shot-holes covered over with canvas as soon as they were made! I have since applied to their lordships for copies of the reports made upon the trials, but their lordships were unable to comply with my request.

And here I may be permitted to mention a remarkable idiosyncracy of Lords of the Admiralty, viz., that they seem to consider it a special function of theirs to deny to the British press and the British public, and to the natives of minor states from which we have nothing to apprehend, information, and facilities for gaining information, which they cheerfully accord to officers of the French, Russian, Austrian, American, and all other Governments which can by any chance prove inimical to us. I have known Russian officers, in particular, have authority to pass freely over our dockyards, while Brazilian officers are refused permission to enter the gates even to see a ship launched, and while Englishmen have to go about under the *surveillance* of a policeman. While no manifest good results from this system of being needlessly communicative to dangerous foreigners, and needlessly secretive to innocent Englishmen, it has the effect of occasioning much unnecessary and injurious babbling in newspapers and elsewhere. When all that the Admiralty do is done secretly, so far as we are concerned, men the most insignificant, whom a plain fact or two would appal, consider themselves quite safe in penning grandiloquent essays upon Admiralty shortcomings; and even just and able men are often betrayed into false criticism. And a greater evil is still to be found in the trouble occasioned by incompetent persons undertaking to do the work which the Government appears to neglect so grossly. Scores of well-meaning men, at this moment, believe that the offices of the Admiralty and the Surveyor of the Navy stand in the midst of all the bustle of modern progress, like a kind of sleeping palace, to the inmates of which—

> Faint murmurs of improvement come,
> "Like hints and echoes of the world,
> To spirits folded in the womb;"

—such men never thinking for a moment that most of the propositions which they are content to put forward in the crudest possible form, have long since been thoroughly examined, down to their minutest detail, in the offices at Whitehall.

And while I am speaking, parenthetically, I would remark that there are some facts now kept scrupulously secret by the Admiralty to which publicity should undoubtedly be given, viz., the results obtained on the trial-trips of the steam-ships of the navy. These are of the utmost importance to men of science, who are anxiously waiting to apply them to the elucidation of difficult questions of fluid resistance—questions of fundamental importance in naval architecture; and as the ships were built, the engines provided, the fuel furnished, the facts observed, and the results recorded, all at the public expense, it is difficult to see by what right any paid servant of the Crown or country prints these documents—still at the public expense—and then turns the key of his desk upon them. This subject must be pursued hereafter, if the ground of complaint be not removed.

But, to return: the floating batteries built by the Admiralty are undeserving of that utter condemnation which some have pronounced against them. Sir Charles Napier, for instance, committed a great error when, in a letter to the *Times*, he mentioned "Iron floating batteries which could hardly swim, and if they could would have been useless, for had they been placed within

400 yards of Sveaborg they would have been annihilated, and at 800 yards, they would have done no harm." Those batteries are armed, as before stated, with 68-pounders, and Sir Thomas Hasting's experiments on the *Prince George* hulk twenty years ago proved that at 1,200 yards 68-pounders are highly destructive, and we all know that they are so at even much greater ranges. The true defects of the batteries lie, not in any weakness of armament, but in their slowness of speed, their unmanageableness at sea, and, as the late experiments appear to show, the weakness of their frames.

But scant justice would be done to the designers of H.M. ships if I were to omit to state that the difficulty which besets this question of the construction of iron-plated war ships—of which we have lately heard so much—is far greater than amateur designers appear to understand. Of the many scores of propositions which have been made of late years but extremely few will bear the test of a practical embodiment. The first, and, indeed, the only very serious difficulty experienced in designing ships to be plated with iron four inches thick and upwards, is that of supplying sufficient displacement to sustain the imposed weight without resorting to great draught of water or immoderate dimensions. Various devices have been proposed for evading this difficulty, the most notable of which is, that of covering a portion only of the vessel with armour plates—the bow, according to some; one side of the ship, according to others. These plans are for the most part attended by too many and too great disadvantages for them to be adopted. Propositions have likewise been made for covering ships with strips of iron, filled in between with hard wood; for reducing the thickness of the iron plates and backing them with india rubber; and for many other modified arrangements. But hitherto experiments have proved adverse to these plans. It has been further suggested that the submerged portion of the ship might be made much longer than the portion above water. This plan has been adopted to a limited extent (for a different purpose) in the French gun-boats; and, although experienced naval architects will discern several objections to this mode of construction, it appears to me likely that the displacement might in this way be increased without the entailment of any great drawbacks.

Another proposal which I have met with in several quarters is that of reducing the thickness of the iron armour and placing it at an inclination, in order to reduce the effect of shot, which are supposed to strike horizontally. The name of Mr. George Rennie is most prominently associated with this proposal, in consequence of his having read a paper in advocacy of it at the British Association in September last. Mr. Rennie prefers the use of curved plates, but as a curved surface is but a surface of varying inclination, the principle involved is of course the same in both cases. It needs, I find, no appeal to experiment to show that the proposed arrangement would not be attended by any advantage. The simplest theoretical consideration shows that, for a given height of bulwark, the same quantity of metal will be required to resist a given blow, whatever the inclination may be. If a shot moving horizontally strikes an inclined plate, the crushing force exerted upon the plate is equal to the crushing force which would have been exerted upon it if upright, multiplied by the sine of the angle between the inclined plate and the horizontal. To keep the crushing effect constant, therefore, the thickness of the metal must also vary as the sine of that angle; and since the length of the inclined section varies inversely as that sine, the sectional area of the plate, and consequently, its weight, remain unchanged. Hence, the side of a ship will require the same weight of metal upon it in order to resist horizontal shot whether it be upright or inclined. The curving of the plates would render it necessary to make them of a variable thickness throughout, if the minimum amount of metal is to be used, and I need hardly say, that plates could not practically be used in this manner. Another important objection to Mr. Rennie's system is, that an inclined side would be much more injuriously exposed than a vertical side to the action of shot and shell fired from long ranges, and of a plunging fire like that of the "Wasp" battery, from which several ships suffered so severely in the attack on the sea-faces of the fortresses of Sebastopol.

Sir Charles Napier's plan of cutting a three-decked ship down to a frigate, covering her with thick armour plates, fitting her with a screw, and arming her with 10-inch guns, as proposed by him in the House of Commons in April last, superficially appears a very reasonable one. At the same time it is one that Sir Charles himself would probably, on mature reflection, consider it not prudent to adopt. It would cost from £80,000 to £100,000 to alter a single ship in this way, and when altered she would be deficient of some of those excellent qualities which he has for many years justly extolled.

It is time that all those who concern themselves with this great question of how iron may best be rendered available for the defence of ships' sides, should recur to the circumstance which gave rise to it, and to the true end to be at present attained. That circumstance undoubtedly was the introduction of Paixhans shells into naval warfare; and the end desired is the application of means by which the entrance of those terrible missiles through the side of a ship may be avoided. The attainment of this end would leave us subject only to the entrance of solid shot, to which all our ships were exposed during the wars in which we won our supremacy, and from which no practicable system of iron plating can at present be expected to save us. The attempt to build ships which shall be proof to solid shot—at least, to wrought-iron solid shot—is an altogether illusory one; and such ships are not urgently required. It is as a defence against shells, and hollow charged projectiles generally, and against these only, that iron plating can yet be made available. By applying iron of very great thickness between wind and water, we may reduce the liability to injury by shot at that important part, and it may be well to do this; but if the upper works are made shell-proof we can expect no more. These considerations reduce the question to a form in which it may be practically dealt with, and I doubt not the solution of it is not very distant.

The only suggestion I have personally to offer upon the point is one in which I find I have, like many others, been altogether anticipated by the gentlemen at Whitehall, but which I may nevertheless mention. It will be evident that fifty feet in length of iron plating on the bow or stern of a vessel, while they would weigh the same as fifty feet of similar plating near midships, would cover and protect a much smaller volume of the ship. I would propose, therefore, that the midship portion of the ship only be protected, and that it be separated from the forward and aft portions by strong iron water-tight compartments, so that, however much the extremities might suffer, the ship would still be safe, and the men protected. Means would of course have to be provided for extinguishing any fires which might be occasioned by shells in the undefended portions of the ship. This plan has been considered, I believe, but whether it is judged favourably or not I am unable to say—probably not, as it does not appear to afford any defence against raking shot.

I have yet to notice a correspondence which has lately appeared, chiefly in the *Times*, on the construction of what are called "steam rams," in mentioning which reference need only be made to the designs of Mr. J. Nasmyth, and Vice-Admiral Sartorius. I have not taken the trouble to inquire who first invented them, because I consider little invention was necessary in the matter, when the mind was once permitted to contemplate the use of such agents of destruction. Any merit that may exist in relation to them must arise either from

the development of special adaptations, contrived so as to render the embodiment of the general principle practicable, or from the setting forth of arguments tending to show the possibility of employing such agents with undoubted advantage. Neither Mr. Nasmyth nor Admiral Sartorius has hitherto done either of these things publicly. Mr. Nasmyth informed us, in the *Times*, that he sent detailed plans of his proposed vessels to the Admiralty, several years since; and were his time less occupied than it is just now by those scientific studies and labours for which he is so justly and eminently distinguished, we should have had the satisfaction of examining similar plans here this evening. In the absence of these, however, it is impossible to say whether he has fully grappled with the practical difficulties which have to be overcome, and fully arranged those details in which the whole question of practicability or impracticability is really, in such cases, involved. I have some reason, however, for thinking that Mr. Nasmyth has done much in this respect; for, on requesting him to inform me if he had made provision for enabling the engines of the ram to sustain the shock of a collision, I found that, although he did not apprehend derangement from this cause, yet he had anticipated it in his plans, and provided for it. This he did by placing the engine and boiler on a slide bed, and furnishing it with suitable elastic buffing material to admit of the slight run forward, which might tend to take place at the moment of collision. The screw-propeller shaft would, in like manner, have a suitable tube socket connection, which would allow the engine to slide forward, and yet keep up the integrity of the connection between itself and the screw-shaft. Mr. Nasmyth proposes to use no guns, but to content himself with the effects of the collision, which he enhances by the use of a powerful submerged percussion shell, which should strike the enemy several feet below water, and thus effect a ruinous breach, leaving her no chance of escape. He asks the government to make experiments with such a vessel, and believes that a "covey of such chicks" would effectually preserve our coast from attack. The scheme of Admiral Sartorius differs from that of Mr. Nasmyth only in the addition of an armament of heavy guns to his vessel, and in the suppression of the percussion shell. He would of necessity require a large vessel; indeed, he himself proposes to cut down the *Great Eastern*, cover her with shot-proof iron plates, fit her with a screw at each end, arm her with heavy guns, and make a ram of her. I should add that he would build upon her towers, from which scalding water might be pumped upon boarders. My opinion is, that there is not a steam-ship in our navy, nor even a sailing ship which, except in a dead calm, would not evade the blow of such a vessel. If a ship would lie at rest and wait for her, the gallant admiral's cheme would answer perfectly, but no long ship—which must neeessarily occupy considerable time and space in turning—could be expected to answer the end which he assigns to her. Of the two schemes, Mr. Nasmyth's is by far the most promising; since, by excluding the armament, he could keep his vessel comparatively light and short, so as to be easily steered; but whether his percussion shell would be effective against the iron plates which would, of course, be carried down to resist it, and, at the same time, leave his own craft unscathed, is a very doubtful matter.

Before quitting this branch of my subject I ought to add a word on Mr. Macintosh's system of warfare, which Lord Panmure for a time forcibly suppressed. It consists in surrounding fleets or fortresses by floating naphtha, firing the same with potassium or otherwise, and thus enveloping the enemy in a cloud of vapour which either destroys him or drives him from his guns. This is not a mere theoretical proposition made without consideration, the inventor having chartered a vessel during the war, and proceeded to the Black Sea with a cargo of naphtha for the purpose of attacking Sebastopol. His amiable intentions were frustrated by the indisposition of our admirals to adopt so great an improvement.

Having now hurriedly reviewed the modern changes which our ships of war have undergone, and glanced at those floating suggestions which some are so eager to urge upon the government, it will be well to consider for a moment a few facts bearing upon the immediate future of our navy. And, first, there cannot be a doubt that the government can, if they please, hasten the introduction of great and radical changes. It is perfectly within their power to build ships of war of a far more destructive character than those which this or any other nation now possesses. But would it be politic for us to take the lead in such innovations? A navy like that which we possess involves, it should be remembered, the investment of an immense amount of capital. The cost of a ship of war when rigged and equipped may be estimated at £35 per ton, exclusive of the cost of her armament, and the engines involve a further expense of, say, £60 per nominal horse power. We have in our navy at the present moment 607 fighting ships, of an aggregate burden of 665,220 tons, and carrying engines of scarcely less than 100,000 horse-power. Therefore our ships alone have cost us nearly £22,000,000; and upon their engines we have made a further outlay of nearly £6,000,000. Consequently, we have invested in these ships nearly £28,000,000. Now, any radical change in the construction of war ships must tend to render this enormous sum of money lost to us, and entail upon us a fresh expense of like or of greater amount. No other power has so large and expensive a navy, and, therefore, no other nation has so much to lose by sweeping changes. As good economists, we should not then be over hasty in developing new means of naval warfare in times of peace.

The defence of our coasts is, of course, at all times a legitimate subject of improvement, and no necessary pains should be spared in rendering that complete. But that may be best done by manning a sufficient number of the ships we have, rather than by devising new ones; and the existing government will deserve great praise if they provide the means of doing this. There is no sign of weakness now visible in the navy of England save in its lack of men. The ships we possess carry no less than 15,140 guns, and could these be all discharged at once, would, at each round, project 254 tons of iron! In one day of twelve hours, firing but one round per minute, they would therefore project 914,000 tons, enough to form a solid cannon ball 120 feet in diameter. To fully man all these ships, and bring all their powers into play, we should require but 162,000 men, and if we had but a fair proportion of these to call upon in an emergency, our defence would surely be complete.

It will probably be objected by some that the French and Americans are building a new class of formidable vessels, and that we must, therefore, do the same. But the assumption of such objectors requires proof. The "ram's nest," lately discovered in America, is very much like another kind of nest which some people are very often finding. The "ram" that it contains need occasion no alarm. It has already cost the American Government 800,000 dollars, and a committee appointed to examine it is said to have reported that it will take 800,000 more to complete the operations begun. It is, therefore, exceedingly likely to remain in its nest for very many years to come; indeed, an American scientific paper some time since pronounced it fit only for exhibition to visitors, at three cents. a-piece, as a monument of folly. As to the French, they have, like ourselves, many inducements to refrain from great innovations. Where we have 60 steam line-of-battle ships they have 30; where we have 330 steam ships they have 220; and where we have 600 ships in all they have 400. Further, much that we have heard of their proceedings is not only false, but ridiculous. The rumour that they were building six *polished steel* frigates, by which some persons were recently plunged in deep distress, was mani-

festly put forth to excite our foolish fears; and statements less evidently absurd are doubtless often started with a like object. The French navy itself, though too costly to be thrown lightly aside, is greatly inferior to ours, as we have just seen; and the Emperor can be doing nothing that our Government are not advised of, and which they are not, therefore, at liberty to do also; and doubtless would do, were it anything formidable. Certainly nothing yet made public need excite our apprehension. Give us a strong Channel fleet, liberally manned and well disciplined, and no power that the French, or any other Government, possesses would dare to menace our coasts; nor would any man venture to say, with Sir Francis Head, that nothing but the will of a foreign Emperor kept London secure from a foreign army.

Let it not be thought that the economical considerations before alluded to should be suppressed in the discussion of this topic. Certainly, economy should not be carried so far as to cripple the Government in defending either Great Britain or its dependencies; nor should it be permitted to impede those researches and experiments which may be essential to the full and prompt development of our strength in time of war, should that arrive. But surely this country, with no offensive or aggressive ends to attain, and yet possessing a navy worth twenty-eight millions of money, and crowded, as it is, with a fearless and patriotic people, need not wince at every hostile whisper, or spend another million on war-ships every time a foolish foreigner boasts; nor can it be amiss for such a nation to count the cost of so timorous a policy.

But if we are resolved on advancing at full speed in these matters, we have need to prepare ourselves for such navy estimates as we have never before known. For there never was a period when the art of naval warfare was more susceptible of change than it is at this moment. Fifty years ago the dimensions of vessels were, by common consent, at least, limited; the power of our ordnance was practically stationary; the winds of heaven were our only propellers, and blew on all fleets equally. But now we build frigates much larger than the line-of-battle ships of that day, and know of nothing to hinder us from building them twice as large if we will. Our guns are incessantly improved,—now by one, now by another, and the breech-loading rifled cannon which Mr. Armstrong has just given us, and which ranges, I am told, four miles, may be quickly succeeded by another of twice its range. The paddle-wheel has made us independent of sails; the screw has made us independent of the paddle-wheel; and the 200 horse-power engine of the *Rattler* has been followed by the 1,000 horse-power engine which is to drive the *Mersey*, and that may speedily be replaced by one ten times its power. A single improvement in the manufacture of iron, which hundreds are now seeking daily to improve, may at any moment give us the means of carrying our steam pressure to unheard of heights,* of resisting shells with the utmost ease, and of augmenting the strength of our ordnance tenfold. By eagerly arming ourselves with all the warlike agencies with which science may thus supply us, regardless of all consequences, we may certainly make our navy most terrible; but we shall at the same time, by the very preponderance of our might, compel all other powers, secretly at least, to make common cause against us, and thus prepare the way for universal strife. On the other hand, if we content ourselves with vigilantly observing the changes which other powers make, and adopting only such improvements as are necessary to keep alive that wholesome respect which all nations now feel for us, we shall neither encourage ambitious powers by our weakness nor alarm timid powers by our strength, but shall continue to stand a solid and impregnable bulwark in the shelter of which men may peacefully work out their highest and noblest destinies.

* A simple but very important improvement in boiler plates, lately introduced by Messrs. Alton Fernie, of Derby, deserves mention in this connection. It consists in thickening the sides of plates, and bending the thickened parts to form the angles of boilers and other vessels, so that the ordinary plates may be rivetted directly to the turned down portion of the thickened plate without the use of angle iron. The full value of this invention it would not be easy to state. In addition to its direct advantages. it has the further one, doubtless, of getting rid of that unexplained, but very common cause of failure of boiler plates, not at the joints, but in their neighbourhood.—E. J. R.

DISCUSSION.

Mr. C. MACINTOSH, in complimenting Mr. Reed on his able paper, could not but say that the magnificent steam navy, to which allusion had been made, sailed to the Euxine and the Baltic, and having taken up positions before Sebastopol and Cronstadt, remained there for months without doing anything in the shape of attack. The Admiralty were informed, in 1853, of the number and calibre of the guns in these fortresses, which, by their concentrated fire, were sufficient to annihilate half-a-dozen British navies. The approach could only be made by a certain path, which was commanded by guns sufficient to sink 500 ships. Thus the British fleet remained out of range of the guns of the forts, their own guns being also unavailable for attack, and all they did was to keep the rats in their holes. His object had been to introduce to the authorities of the Admiralty an invention* which would have enabled the English fleet to have advanced under cover of a thick vapour close up to the sea faces of the fortresses, when they could have poured in a concentrated fire that would have annihilated them. In the attack upon Sinope the Russian Admiral waited for one of the Black Sea fogs, which so frequently occurred, under cover of which he advanced to an attack which, though bloody in its issues, he (Mr. Macintosh) regarded as the most brilliant action of the whole war. He submitted that if his plan had been carried out during the Russian war, the lives of 50,000 brave soldiers might have been spared, and the expenditure of millions of money saved to the country. Mr. Macintosh entered into a description of his plan, which consisted in diffusing a large quantity of naphtha upon the surface of the water, either around a ship, or in front of the sea face of a fortress. This body of inflammable matter was lighted by firing a prepared shell containing naptha and potassium into it, and thus an impenetrable vapour was created, under cover of which an attack could be made with the most destructive effects.

Vice-Admiral Sir GEORGE SARTORIUS said, his name having been mentioned in the paper, he would offer a few observations with the view of clearing up that which would otherwise be somewhat unintelligible. When Mr. Reed communicated with him on this subject, he asked for information which was unpublished. He then presumed that Mr. Reed was fully acquainted with the correspondence that had appeared in the *Times* with reference to the steam ram; but from the statements made by Mr. Reed, it was clear that he was not fully acquainted with that correspondence. It was more than two years since the subject of steam rams was brought before the notice of the Admiralty. But the proposed adaptation of the Great Eastern ship to that purpose had only been recently put forth. When he proposed the plan of steam rams to the Admiralty, he was not aware that a similar suggestion had been made by Mr. Nasmyth, and he felt proud that he should have conceived an idea which was participated in by so distinguished a man. The plan suggested itself to his mind from having noticed the results of the collisions of vessels at sea, the effect invariably being that when an iron steamer propelled at great velocity, came in contact with a vessel moving at less speed, the latter sustained serious injury. As to the form best adapted for an aggressive engine of that description, not being

* See *Journal*, vol. vi. p. 681.

himself an engineer or a ship builder, he did not consider himself competent to determine it. He therefore consulted with persons more particularly acquainted with the subject than himself, and amongst others, Mr. Scott Russell. They had all told him that there was no difficulty in constructing a vessel of suitable tonnage and form with sufficient weight of iron around it, and propelled by a power that would sink any vessel with which it came in contact. He had proposed a vessel of from 3000 to 4000 tons, to form a shot-proof steam ram. If it was admitted that such a vessel could be constructed shot-proof, he would ask any practical sailor how it was possible for a fleet of twenty or thirty vessels to resist the effects of such an engine of destruction. The masts could be lowered, and by having a rudder at each end, the difficulty of turning the vessel, alluded to by Mr. Reed, would be obviated. He proposed to have the keel slightly curved so that the vessel could be more rapid in changing the direction of its movements, and by the extent of steam power employed, it would have considerably higher speed than the ships of the present day. A subsequent proposition of his has been to furnish the vessel with guns from which shot filled with molten iron could be discharged, which would fire the wooden ships against which they were projected. Another project was the suspension of percussion shells from the bow, which could be fired by the concussion of the two bodies. A vessel so armed would sink the largest ships afloat, whilst the projectiles would set them on fire. He confessed, that the introduction of Armstrong's new gun had tended to alter his views upon this subject, for it was evident that a shot from that gun would go through every thickness of iron that could be reasonably used in the construction of a vessel. Under these circumstances, he maintained that ships built of timber would be useless in any future war, and if the plan of the steam ram were a favourable one, ordinary iron ships of war would be alike useless.

Mr. WILLIAM HAWES said, after hearing a paper so simply yet so eloquently written as that which had been read that evening, it was rather hazardous to get up and object to one or two principles which it advocated; but there was one sentence in particular which grated harshly on his ear—it was with reference to the contracts by private builders during the late war—and Mr. Reed had stated that the evils of pecuniary losses were greatly aggravated, if not altogether occasioned, by the excessive demands for wages made upon the contractors by their workmen. He thought great injustice was done in that observation to a class of men to whom this Society ought to pay the greatest respect. He believed that if the truth of the matter were known they would find that the contractors, and others filling positions above those referred to, took advantage of the war to increase their charges to a much greater extent than had been done by those in their employment. He was at all times anxious to defend workmen from such charges as these, and he thought in all statements made in public we ought not to lose sight of the position in which both masters and workmen were placed in cases of great emergency. There was one other important principle advocated, namely, that we were to sit still and wait till improvements were introduced in other countries before we adopted them. That, certainly, was not the principle which had guided us with regard to the manufactures of this country, and he should be sorry to see the time arrive when that plan would be acted upon with reference to our vessels and instruments of warfare.

General Sir CHARLES SHAW, as one not acquainted with naval matters, said he, ought to apologise for offering any observations on the subject. He had served as commanding the marines under the gallant Admiral in the chair, as well as under Admiral Sartorius. With reference to the question—how was the propulsion of vessels to tend to our national defences—it had often occurred to him that, with the means at present in use, an entire system of military improvements could be carried out with a fleet of steam ships in the same manner as with a brigade or division of an army on land. The introduction of those new instruments of warfare—the Enfield rifle and Armstrong's gun—had completely changed the system. What was the use of fortifications, when they could be attacked from a distance of five miles? They must build their arsenals inland, and by the aid of the electric telegraph an order could be executed as well at Coventry as at Portsmouth. Supposing an enemy destroyed the coast defences, they could not command more of the country than their shots could reach. Therefore, if they drew up a second line of defences out of range, no enemy could land.

Captain NORTON mentioned that, with the present military rifle he had pierced an iron plate $\frac{7}{8}$ths of an inch thick at a distance of 60 yards. He had for some time anticipated that rifled ordnance of the largest size would come into use.

Mr. JAMES NASMYTH, upon being called upon by the Chairman, said that the plan of his steam ram had been so widely discussed by practical men in all quarters, that it would be imposing upon the time of the meeting to enter into any detailed description of it; but he was at any time ready to answer any distinct question that might be put to him with regard to it, in order to elucidate any points in its construction which might not have been given with sufficient clearness.

Mr. J. SCOTT RUSSELL, F.R.S., was afraid the hour was almost too late for him to take up their time with what he had wished to say, and to bring the discussion back again to the special scope and peculiar objects of the paper. All who were in the habit of meeting in that room, must feel that the paper which they had just heard was a most valuable one; and it was particularly valuable to himself, as he had been endeavouring to get together for his own use, the information which that paper contained, forming the history of the progress of our navy during the present century. There were, however, one or two points in it upon which he felt it his duty to say a few words—not because they were topics peculiarly his own, but because he thought it necessary in justice to other people to do so. Mr. Reed had in his paper very carefully given to every man whose name he had mentioned his due share of blame for his mistakes, and approbation for what was right. He agreed with Mr. Reed that it was a great misfortune for England that at one time other ships were constructed—he would not say with a total want of principle—but upon maxims which were opposed to all received principles. It was the doctrine for a considerable period of time in the Admiralty, that science could do nothing whatever for shipbuilding, and that there was no greater qualification for a shipbuilder than that he should know nothing whatever of the subject. Whilst he quite agreed with all that Mr. Reed had said of Sir William Symonds and his school—if he had a school at all—he would say that they must give that officer credit for one thing—namely, that he was the means of introducing into the navy the large, broad batteries which his ships first set the example of carrying, although they did not carry them well. The large batteries were still retained in the navy, and ships suited for carrying them were now scientifically constructed. Sir William Symonds was an admirable seaman; but to believe that because a man was a good sailor, therefore he was a good shipbuilder, was much the same as to say that because they had a good coachman they would set him to build their coaches. He knew Mr. Reed to be an educated naval architect, and he therefore thought that he might have dwelt a little more upon the very great merit of the more modern school of naval architecture, which he might say had overthrown Sir William Symonds, and had now taken his place. It was, perhaps, not generally known that during the official reign of Sir William Symonds, there was, struggling against every difficulty, a body of trained

naval architects of very high scientific attainments. That young school of naval architects struggled through the opposition which the authorities of that time threw in their way, and determined to introduce scientific naval architecture practically into the navy. They were appointed by a more enlightened Board of Admiralty that came into power at a later period, a committee of naval architects, and during the reign of Sir William Symonds, that committee (one member of which, Mr. Chatfield, he saw present)—discussed the principles on which the future fleet of England should be constructed. They produced a report, which he was afraid was not made so accessible as it ought to be. He had himself obtained a copy of that report in a circuitous way. Those gentlemen however produced a treatise upon naval architecture, which he had no doubt would be given to the world at some time or other, and which would do great credit to the authors. About a dozen gentlemen constituted that school of architecture. The present surveyor of the navy on coming into office, adopted a very different principle from that of his predecessor. He said, "I am surveyor of the navy, but, understand, I am not a naval architect. But I will do this: I am an experienced sailor. I know what I want in a ship; and what I will do is I will associate with myself the most eminent naval architects I can get. I will tell them all that I want in a ship, then they shall inform me in what way they will give me what I want." It had been his (Mr. Scott Russell's) theory that two men were necessary to the designing of a ship—one, the naval architect, and the other the man who had to fight her. That was the reason why there should always be a naval man in the construction of a ship as well as a ship-builder. It was this state of things which had raised the navy of this country to its present state of efficiency. He was one of those who were often finding fault with the Admiralty; it was, therefore, a great comfort to him to say all the good he could of them. They were going on very rapidly making great improvements, and they certainly did wonders in the last war. He believed they were not standing still now, but had their eyes open. Still he thought they required a little pressure from such persons as the gallant Admiral in the chair: and even this paper and the discussion upon it might help them to go forward. He believed there were some men upon the Board of Admiralty who wished to go on very fast, and no doubt there were others pulling them back. If, therefore, the screw were put on, they might be induced to move forward. He thought they owed much to the present Surveyor of the Navy. It was to the Admiralty authorities that the introduction of tubular boilers was to be attributed, which formed so large an element of economy and speed in merchant vessels. It must not be forgotten, moreover, that we owed to the Admiralty the introduction of the screw-propeller. It was not introduced so soon as it ought to have been, but it was introduced a great deal sooner into our ships of war than into the merchant service, and Government ought in fairness to have the credit of this. With regard to the construction of iron batteries and iron frigates and rams, he thought there were one or two persons who ought to be done justice to. The introduction of iron plates originated not with the Emperor Napoleon, but with Mr. Stevens, the great steam-boat builder of New York, who was in this country ten years ago, and who then communicated to him (Mr. Scott Russell) the results of some experiments that had been made by the States' Government with regard to iron plates. Much had been said about the great steam ram which was building in America, and which had been commenced by the same gentleman, but from all that he (Mr. Russell) had heard about it, he thought it was a very clever idea, quite clever enough to be begun, but a great deal too clever ever to be brought to a successful issue. He believed they were indebted to Mr. Lloyd, of the Admiralty, and not to Louis Napoleon, for the idea of the four-inch iron plates. The Emperor suggested the putting on of a number of thin plates to make a thick covering, but Mr. Lloyd suggested that one thick plate would answer better. He sent to the contractors to ask whether they could make these large four-inch plates. They said it was impossible, but, nevertheless, if they were ordered, they would do it, and they did it as a matter of course. He would say one word in reply to what had fallen from Mr. Hawes. He (Mr. Scott Russell) did not believe that any manufacturer or builder of ships for the Admiralty during the war put on the screw in the way of money at all. They felt that the Government was in a difficulty, and he knew that the prices at which they then built for the Admiralty were less than those at which they were now contracting for the same description of ships. With regard to himself, he would mention that the Admiralty applied to him to cast some guns in a great hurry. He replied that he could not undertake to do it because the price he must necessarily ask would be greater than he found they were paying other people; but he offered to place his foundry at their disposal during the night, without charging them any profit, but that they should appoint a person to see how much money was spent, and if they paid that he would be satisfied. Others with whom he was acquainted acted in the same way. He was happy also to say, on the part of the English workmen, that the great proportion of them acted in a similar spirit; but he was sorry to be obliged to add that some of them, when they found that those vessels of war were wanted in a hurry, asked that their wages should be raised from 7s. to 8s. 9s. 10s. 11s. 12s. and even 13s. per day; and they struck work and left the yard, because when it came to 13s. 6d. it was refused. These were exceptions. As a general rule, the workmen of England during the war came out nobly, and the few instances he had mentioned were the rare exceptions. He was always proud of the workman when he did right, and looked upon him as an equal, and was never so much ashamed, being a workman himself, as when one of that class did wrong. He would sit down with the expression of his thanks to Mr. Reed, for the very valuable matter he had brought before them that evening.

Mr. DITCHBOURNE, in reference to the statement just made, that the present Surveyor of the Navy had called in the aid of naval architects, thought an injustice was done in that respect. In his opinion, the more suitable place for the Surveyor would be a seat at the Board of Admiralty, and that a naval architect should receive the appointment of Surveyor of the Navy.

Captain FISHBOURNE, R.N., as a naval officer, would tender his thanks to Mr. Reed for his able paper. He would remark that as it appeared at present impracticable to manufacture iron plates strong enough to resist the passage of solid shot, their attention ought to be turned to precision of fire from the guns. This appeared to have been attained to a wonderful degree by Armstrong's rifled cannon which, at 1500 yards, was said to be 50 times more accurate in its fire than any other description of cannon. Assuming that to be the case, one of those guns would be equal to 50 ordinary guns at 1500 yards. The precision of fire was so great as that they could send the shot into the port hole every time, by which the enemy's guns might be destroyed, and the men working them killed. With regard to iron plates for covering the sides of ships, he thought there was a difficulty which could not be got over—namely, that to obtain the requisite thickness of iron to withstand shot, the displacement of the ship would be so great as materially to detract from her usefulness, the great point being to get ships that drew as little water as possible.

Mr. REED, on rising to reply to the several speakers, took that opportunity of stating to whom he was indebted for the display of models and drawings with which his paper was illustrated. For the several models of ships, he had, he said, to thank the Secretary of the Admiralty,

who had granted the use of them without hesitation. He directed especial attention to a splendid model of H.M.S. "Euryalus"—in which a royal prince had lately proceeded to sea, for the purpose of acquiring, not valour, for that was doubtless born in him, but the skill which would enable him to apply his valour wisely. For highly finished working models of a marine engine and a breech-loading cannon he had to thank Mr. Joseph Maudslay, of whose valuable improvements they were good examples. A series of coloured lithographs, representing the combined fleets during the late war, had been kindly lent by Messrs. Day and Son, of whose productions they were excellent specimens. The large drawings illustrative of Mr. Macintosh's system of warfare were furnished by the inventor. The various speakers who had noticed his paper were so kindly in their criticism, that he had but little to reply to. He felt bound to say, however, that he had scarcely done justice to Admiral Sartorius in preparing his paper, not because he was unacquainted with the letters of the gallant officer, but because the time allotted for the reading of the paper was too short to admit of elaboration. His great objection to the present introduction of such vessels as Admiral Sartorius proposed was based, however, upon the consideration that it was unnecessary, and would be impolitic for us to enter upon the realization of such plans unless other powers first resorted to them. With regard to the turning of the ram when under weigh, it would be evident that, while the use of a propeller at each end would render it unnecessary to turn the vessel completely round, it would by no means obviate the necessity of rendering her capable of changing her direction suddenly while in pursuit. But this was a matter of detail, and, as he had before said, he had not attempted to fully discuss the details of the steam-ram question. With respect to the observations of Mr. Hawes, he (Mr. Reed) accepted as his own the reply which Mr. Scott Russell had so efficiently made in so far as the contractors and workmen were concerned. As to the resistance to progress which, as Mr. Hawes alleged, he had offered, it would be understood that one of the reasons why he (Mr. Reed) advocated moderation in the arts of war was that the arts of peace might thereby be promoted. In reference to Sir Charles Shaw's observations, he would simply remark that Sir Howard Douglas's "Naval Warfare," recently published, consisted principally of an able essay upon the application of military tactics to naval warfare with steam. In Captain Fishbourne's observations he discerned nothing that was not entirely in accordance with the paper he had had the honour of reading. To Mr. Scott Russell he was much indebted for the very excellent and able manner in which he had supplemented the paper, by remarks which were not only pertinent but most necessary, and which could not have been made by any other person with the same authority as the name of Mr. Scott Russell invested them with. If he (Mr. Reed) had passed lightly over the services of the members of the School of Naval Architecture, or, indeed, of any other person or persons, he must plead the enforced brevity with which he had written.

The CHAIRMAN said it was now his duty to propose a vote of thanks to Mr. Reed for his paper, which he must say was drawn up with great ability, and contained much valuable information. Before doing so, however, he would make a few observations upon one point of the paper especially, in order that it might not go forth to the public that we had the large available naval force there spoken of. Mr. Reed had stated that the fleet of screw steam ships consisted of fifty-one line of battle ships, each armed with 8-inch shell guns and 32 pounder solid shot guns, &c. Mr. Reed, in making that statement, undoubtedly meant that we had built and launched 51 sail of the line. He could not mean to convey that there was that force ready for service at the present day. He (the Chairman) sincerely wished there was, and then all their fears about invasion would be groundless. He believed there was not more than half that number. Of course he alluded to screw line of battle ships; because he regarded all sailing ships of war as so much waste timber, and the sooner we got rid of them the better. Mr. Reed had very truly said, that what was required was a well-manned Channel fleet, and with that we could set at defiance all the powers of Europe. But the difficulty was to get such a fleet—he meant a fleet manned by really efficient seamen. A Royal Commission was now sitting with a view to find out what were the real grievances of the sailors, and what was the reason men did not more readily enter the navy. He believed that commission would very shortly make its report, and he trusted that the Government would pay attention to it, emanating as it would from able and experienced officers, and not throw it aside as had been done with the last report made to them. A good Channel fleet was what he had always contended for; and he would point out in very few words how it could be obtained. They probably all knew that he (the Chairman) had both publicly and privately—in the House of Commons and elsewhere—done his utmost to induce the Government to get up a Channel fleet of only ten sail-of-the-line. He only asked for a fleet of that extent. The late Board of Admiralty paid off the fleet and sent the men to the right-about, even including the continuous service men. He was happy to say that the present Board of Admiralty—though a Conservative one—had done more during the time they had been in office than he had ever seen done by any former Board. It was pretty well known that he was no Conservative himself, but still he wished to do justice to those in office—whether they were whigs, tories, or radicals. When the present Government came into office they cast about to get up a Channel fleet. It was true they had not yet come up to the number which he wished, but they had got six sail of the line. He should continue to urge the Government to get them up to ten sail of the line; and if they had that number of ships well manned with real seamen—not men picked up out of the streets—there would be no difficulty in the event of an emergency in increasing them to twenty. He would tell them how that could be done. They should take ten sail of the line, manned by 1,000 men each. There should be only 100 marines instead of 200 embarked on each vessel, the rest being replaced by 100 seamen, and that would give 900 able seamen and officers on board each ship. The Admiralty were very properly preparing ten sail of the line as a first reserve, and these were nearly ready. In the event of war one watch should be transferred from each ship of the Channel-fleet above-mentioned to the reserve, which would then give a fleet of twenty sail of the line manned by 450 men each; let their complement be filled up by 200 marines and 100 officers and boys, who were always to be had—this would give a fleet of twenty sail of the line manned by 750 men each, and with 250 more for each vessel, called out from the coast volunteers, there would then be a fleet of twenty sail of the line better manned than was the fleet during the last war. This could be done in 48 hours, but he did not think that it was enough. There were now 7,000 of the coast guard, which were to be increased to 10,000, and there were in different sea-ports nine useless block-ships to receive them. For these block-ships he (the Chairman) would substitute the second class reserve of ten ships which were now getting ready, and taking the coast guards to man them, we could have in 48 hours more thirty sail of the line ready for fight, and with such a fleet we might defy the world. Those ships in the different ports would teach the sailors that an English man-of-war was not so bad a service after all. He was happy to say that he believed the feeling was gaining ground amongst the seamen, that to get on board a man-of-war was not a bad position. He regretted that they still kept those immense useless block-ships, mounting 74 guns, with reduced masts and yards, and some of them moved by machinery of only 200 horse power, which Mr. Scott Russell could tell them was of very little use. Of course to provide all

this would cost money, and they must be prepared to hear, when the Navy estimates were brought forward, that we should require a considerable sum more than was at present voted. In his opinion much of the money was now ill-spent. They were now doing what they had never done before; Government was buying land at Plymouth, Portsmouth, and other places, and making immense land fortifications, at a cost of between £300,000 and £400,000; while formerly, when we had almost the whole world against us, the wooden walls of old England were found sufficient for her defence, and this would be the case again; and he considered that the money expended upon land fortifications was thrown away, except in so far as providing a few places with guns, under which vessels could run in for shelter. Let them have an efficient fleet, man it well, and it would be found the cheapest as well as the most effective defence of the country; and no nation, whatever might be the fleet she could send out, would ever then attempt to disturb the peace and happiness of England. It was true that France was making enormous strides. She had built an immense fortress at Cherbourg, and it had doubtless been built to put a large fleet in; and that no doubt would be done some day. France had a large army; this country had next to no army: our troops were in India, and even with the militia the number of soldiers at home was very small. He therefore said it was the duty of all Englishmen to insist upon the Government keeping up a good Channel fleet of not less than ten sail of the line: and that would be the nucleus of 30 sail of the line, which could be manned in the way he had proposed to them. He had thought it his duty—inasmuch as these proceedings would go forth to the world through the press—to disabuse their minds of the notion that we had at the present time 51 sail of the line, which might lead them to suppose that all attempts to get more ships would be useless. He was quite sure that the vote of thanks which he now begged to propose to Mr. Reed would be unanimously accorded.

The vote of thanks having been passed,

Mr. REED acknowledged the compliment, and remarked that inasmuch as the returns he had given of the naval force of France up to May, 1858, included vessels under building and alteration, he thought it only justice to give the same statistics with regard to our navy.

The Secretary announced that on Wednesday next, the 22nd instant, a Paper, by Mr. Leonard Wray, "On Cotton Culture and Preparation in the United States," would be read.

HEALTH OF TOWNS.

In the public health section of the Social Science Meeting a paper was read by Mr. Marshall, the town clerk of Ely, on the results of tubular drainage of the city and the abolition of cesspools or middensteads in five-sixths of the houses, and the substitution of soil pans or water-closets. Instead of large "man-sized" branch as well as main sewers, at Ely the general outfall for the drainage of all the houses was only ten inches, and the prevalent diameter of the sewers was only six inches; and Mr. Burn, the able engineer, declares, that so well do they work that if he had to proceed *de novo*, he would use sizes yet smaller. So complete is their constant action, that they require no flushing, and everything is discharged in much less than an hour from beneath the more distant parts of the town to the outfall. It is reported that it is discharged "so fresh," speaking comparatively, that there is no offensive smell from the openings into the street, and that in the river no nose can detect the place of discharge, and in such a new condition (the grosser being detained and treated with lime) that instead of fish being killed, it is just at the outfall that the anglers find their best sport. He showed that the effect had been to reduce the death-rate from 25.60 to 17.20 per 1,000; or, in other words, as if the whole mortality of the city for one year out of three were intermitted. The average age of death had already been raised there four years and six months to every individual. Dr. Carpenter also gives a statement of the result of the tubular drainage of Croydon. These were stated to be a gradual reduction of the death-rate from 28 in 1,000 in the year of the commencement of the works to 15.90 per 1,000 in the last year. The death-rate, according to Mr. Westall's tables for the last five years had been gradually diminishing thus:

Year:	Rate per thousand.
1853	28.57
1854	26.52
1855	19.75
1856	16.70
1857	15.94

The population had been increased to nearly 28,000, contained in 4,546 inhabited houses. The number of deaths for the whole year was 437, or 100 less than in 1848, when the population was 9,000 less than at present. The death-rate was 15.94, instead of 28.16, leaving a balance of 12.22. To put it more intelligibly, the sanitary improvements have caused a saving in one year alone of 342 persons, if we suppose the mortality would have continued as high as in 1848; or even taking the mean of ten years —five before, and five since they have been in operation, viz., 22.92—the saving has been 196. The character of the disease has also altered.

Medical testimony was read to the effect that typhus had been almost driven out from its former abodes; and there had been a general reduction of sickness by about one-third. A similar report was read as to the results of similar works executed at Tottenham, which had almost cleared away typhus from a number of its former seats. A report was read on the effects of the sanitary improvement of the Arsenal district of Woolwich, where 70 per cent. of the houses had been divested of cesspools; and the result had been a reduction of epidemic or zymotic diseases by nearly one-half. The death-rate had previously been 33 in the thousand—it had early been reduced to 27 in a thousand—last year it had been as low as 19 in a thousand in the district in question. Other reports stating important results were read, in relation to works completed in Ottery St. Mary, Devon, and in progress in Lancaster, Worthing, and in other places; and resolutions were unanimously adopted requesting that the report should be printed and circulated by the council *in extenso*; that the results of the works in other places should be published and circulated for the public information.

Colonial Correspondence.

THE COMET.

Belize, British Honduras, Oct. 17, 1858.

SIR,—On the evening of the 30th of September a comet was observed in the north-east, a little above the horizon. The nucleus was large and brilliant, and the tail long and luminous. The nucleus, which appeared to be about the size of Mars, was of a reddish hue. The tail was of the same complexion near the nucleus and for a considerable distance from it, but gradually became paler and of a more silvery lustre towards the opposite end. The length of the tail was at least a third of the distance between the horizon and the zenith. It spread itself greatly, and at the broad end very much resembled the milky way, as that sidereal region of the heavens is seen in the tropics—not as it is seen in Europe. The motion of the comet was very rapid. As nearly as I could calculate, its apparent motion, when viewed by the naked

eye, was an inch in a minute. It pursued a course from the north-east to the south-west. Every night it rose higher in the heavens, and as it approached the zenith, receded from the earth. The tail at first was nearly parallel with the horizon, but as the comet rose it became perpendicular to it. I have sent you a couple of pencil sketches, which will give you some idea of the size, shape, and course of that eccentric body.

I am, &c.,

R. TEMPLE.

Home Correspondence.

EXHIBITION AT BARNSTAPLE.

DEAR SIR,—I am desirous to repeat, for the information of the members of the Society of Arts generally, the statement which I made from the chair on Wednesday the 8th inst., to those who remained in the room after the interesting discussion on Mr. Halkett's paper, namely, that a large Agricultural Society (the Bath and West of England) is about to extend its Exhibitions so as to include arts and manufactures, as well as objects of agricultural interest.

The Exhbition for 1858 took place at Cardiff, on special invitation from that town, which contributed £800 towards the expenses, besides £1,500 paid at the gates in three days. The Exhibition for 1859 will take place at Barnstaple, in the heart of North Devon, in which district a local subscription of £1,500 has been raised to secure a visit from the Society.

In compliance with the wishes of the exhibitors of agricultural implements, competition for prizes in that department is to be discontinued. The meeting will take the form of a Great Western Baazar for exhibition and sale. The regulations for such an arrangement have been submitted to a large number of the implement exhibitors assembled at the Smithfield Show, and they have promised to support the Barnstaple meeting by sending their best goods. The prizes for cattle and poultry remain as usual.

The Society possesses a plant of waterproof shedding (on a plan invented by Mr. Jonathan Gray, and adopted for hospital tents in the Crimea) capable of covering 40,000 square feet (two thousand feet run of twenty feet wide), for which the implement exhibitors pay cheerfully two shillings per foot run (22 square feet).

Arrangements will be made for more complete protection of articles exhibited, provided that exhibitors are willing to contribute to the expense in proportion to their several requirements. The Society does not desire to make any profit by the shedding.

The object of the extended Exhibition is, to engraft on the rapid improvement in agricultural produce and machinery a corresponding improvement in taste, and, thereby, to extend the local demand for works of art and manufactures, whether useful or ornamental, of the highest quality and the best design. The want of a better market is acknowledged in all the Schools of Design. The Art-Union of Glasgow has already taken one step—we hope to take another.

The retail shopkeeper is often unable—sometimes even unwilling—to step in advance of the taste of his own district. In order, therefore, to try our experiment with any hope of success, we must invoke the favourable consideration of enterprising and intelligent men at a distance. Is it too much to hope that some members of the Society of Arts will be disposed to enter, as a memorandum for the end of May, 1589, "Westward, Ho!"

The show will be open from Monday, 29th May, to Friday, 3rd June, both inclusive. The Secretary is H. St. John Maule, Esq., 1, Wood-street, Bath, from whom further particulars may be obtained. I shall also be happy to give any explanation which may be required, as far as my time permits.—I am, &c.,

THOMAS DYKE ACLAND, JUN.

To the Editor of the Journal of the Society of Arts.

Proceedings of Institutions.

ALTON MECHANICS' INSTITUTION.—The twenty-first annual report of this Institution for the year ending September 30th, 1858, gives a favourable report of its proceedings and shows that it has received a large amount of public sympathy and support. There have been added to the library 138 volumes by purchase, 11 presented, and 3 from the Society of Arts. The total number now amounts to 1,463. The number of books issued has been 2,679. The lectures of the lost season were delivered in the following order: An opening lecture, on "Social Progress," by C. M. Burnett, M.D."; on "British Monumental Memorials," by the Rev. C. Boutell; on "India, Past and Present," by the Rev. F. M. Cunningham; on "Mind," by the Rev. John Banister; two on "Astronomy," by W. P. Snell, Esq.; on "The Present Time," by the Rev. J. D. Snow; on "Martin Chuzzlewit," by Mr. G. Grossmith; two on "The Atmosphere," by Mr F. W. Crowley; two on "Glaciers, Icebergs, and the Philosophy of Natural Scenery," by J. W. Curtis, M.D.; a Shaksperian declamation, "Hamlet," by Mr. A. Francis; a musical entertainment "Melodies of Many Lands," by Mr, G. A. Cooper; on "Electricity," by Mr. Bryant; "Macbeth," a reading, by L. Leslie, M.D.; an exhibition of dissolving views, by Mr. Steward; a lecture on "National Characteristics," by Mr. Stewart. These were, almost without exception, well-attended, and all which required it were beautifully illustrated. A large proportion of them, and many of the most popular, were given by members of the Institution. The fourth soirée of the Institution was held at the Town Hall, on the 8th of April, upon which occasion somewhat more than the usual amount of interest was excited. This arose partly from the opportunity being taken of presentsenting a service of plate to the President, which had been purchased by a subscription, amounting to about sixty guineas, raised almost encirely by members of the Institution. The museum report, sent in by the curator, states that the additions made during the past year are sufficient to show that there is no diminution in the interest taken in the museum by the friends of the Institution. These additions consist almost entirely of presentations either of objects entirely new, or of such as have been previously only exhibited. These embrace mammals, birds, reptiles, insects, plants, minerals, coins, &c., to the extent of about 350 specimens. The entire number of doners amounts to 41. The meetings of the natural history class were kept up during the winter. The first evening was occupied by a description of the specimens recently added to the collections—after which 15 familiar lectures on Geology were delivered by Mr. W. T. Gunner, and five on Reptiles by Dr. Curtis. The secretary of the music class reports that the class is progressing favourably. The number of members is 19, and of hon. subscribers 21. Since the committee put into circulation a prospectus of evening classes for elementary instruction, it has been ascertained that the time for holding them must be later in the evening—it is therefore now announced that the committee are desirous of fixing whatever time is found best to suit the convenience of those who are intending to enter the classes. It appears also to be generally felt that the age of admission should be fixed as low as thirteen years; the scheme would not then, it is thought, interfere with the public schools, and it is of great importance that the classes should be open to receive young men immediately

on their leaving school. The balance on the building fund account against the Institution was, in the last report, £23 14s. 6d. The number of subscribers amounts to 276, viz., annual subscribers of ten shillings, 52; ditto, of one guinea, 51; quarterly subscribers, 134, ditto, who have paid part of the year and have left, 39. Six members of the Institution presented themselves for examination by the Hants and Wilts Adult Education Society. Of these five obtained a certificate, and one of them also a prize of books.

WENLOCK AGRICULTURAL READING SOCIETY.—The annual meeting of this society was held on Thursday, the 21st of October. Sir George Harnage, Bart., occupied the chair, and there were present the Rev. R. H. G. More, Messrs. Blakeway, G. Burd (treasurer), W. P. Brookes, (the honorary secretary), A. G. Brookes, H. Phillips, &c. Mr. W. P. Brookes read the report of the committee, which states that the progress of the Institution hitherto has been satisfactory, but the committee suggest that some material improvement be made in the management of the the lending library, to which, however, the number of subscribers during the past year, shows an increase, as compared with the preceding year, of 17 subscribers to the library and 7 to the reading-room. A long list of presents is given in the report, consisting of books, photographs, prints, autographs, fossils, &c. The following lectures have been delivered: On "Roads and Railroads," by the Rev. J. Hayes, Coalbrookdale; on "George Herbert and his Poetry," by the Hon. and Rev. Orlando Forester; on "The Life of Washington," by the Rev. N. Heywood; on "America," by John Evans, Esq., member of the American bar. With regard to the drawing class, the Government inspector, Mr. Wylde, visited the borough of Wenlock schools, in April last, for the purpose of examining the students for the year ending December 4th last. An exhibition of the works of the students of all the borough schools took place at Coalbrookdale. Eleven bronze local medals were awarded, of which four were gained by students of the Wenlock school. Prizes for free-hand drawing (first grade), were awarded to two National school pupils, who gained the prizes for drawing awarded by the Olympian class, in 1857, and eight students received prizes of the second grade. At the general exhibition of the works of students at South Kensington, in May last, a national medallion was awarded to a student of the Wenlock school. The number of students that entered during the year was 30, but the average of attendance was only 21, whilst the average last year was 33; consequently there has been a falling off of 12 students. The committee congratulate the members on the increasing success of the Olympian class. The usual prizes for useful, intellectual, and industrial attainments were distributed at the last annual meeting. The prize for drawing, viz., two years' free instruction in the Wenlock school of art and six shillings for the purchase of drawing materials, was awarded to Thomas Edwards. The Olympian class will continue the free instruction a year longer, should the student at the end of his second year gain a government local medal. The introduction of tilting at the ring at the meeting for competition in athletic exercises, added greatly to the interest of the spectacle; and the spirit and skill with which the prize, kindly given by the mayor, C. F. Ferriday, Esq., was contested for, gave general satisfaction. Prizes of £5 each for the first, and of £1 for the second, for these matches, and a prize of £1 for the best poetry on the Wenlock Olympian games, will be given next year. R. Jasper More, Esq., of Linley-hall, has offered to give "£5 as a prize for the best essay on physical recreations —ancient and modern—their moral and political value." The committee hope, through the kindness of one of the neighbouring landed proprietors, to obtain a piece of ground, so as to open a gymnasium in connexion with the Institution. The subscriptions to the Olympian class amounted to £34 2s. 8d.; the number of subscribers during the last year was upwards of 300. The philharmonic class consists of 20 members, paying each only 6d. per quarter. They meet once a week for the practice of vocal music. Several young men having expressed a wish to acquire some information in chemistry and botany, which are included in the examination scheme of the Society of Arts, a subscription was commenced for the purchase of a small chemical apparatus and of chemical and botanical diagrams. £23 3s. has been contributed and has been expended in the purchase of apparatus, chemicals, diagrams, &c. Arrangements will shortly be made for the meeting of the chemistry class. The following is a statistical summary of the report:—Subscriptions to the lending library, 87; ditto to the reading-room, 40; ditto the drawing class, 30; ditto to the philharmonic class, 20; ditto to the Olympian class, 305; ditto to the working men's branch, 30; total 512. Number of volumes belonging to the agricultural reading society, 1750; ditto belonging to the working men's branch, 254; total number, 2004. The treasurer's report showed—receipts, £66 19s. 6d.; expenditure, £77 11s. 6d., the balance against the society being £10 12s. After the adoption of the report, a vote of thanks was passed to Mr. Jasper More, for his offer of a prize, as detailed in the report, as well as for his contribution to the library. Some discussion took place in reference to the arrangements of the library, and the election of officers took place. Mr. Blakeway then paid a high compliment to Mr. Brookes, "their indefatigable secretary," and proposed that he be requested to continue the duties of the office for another year;—this was seconded by Mr. Fowler, and cordially adopted. Mr. Brookes acknowledged the compliment, and proposed that Mr. Burd be again requested to act as treasurer. This was also unanimously agreed to; a vote of thanks to Mr. A. Yardley, the librarian, was then adopted, and the proceedings closed with the usual compliment to the chairman. The annual dinner took place at the "Falcon Inn," at half-past three o'clock, under the presidency of Sir George Harnage, Bart.; the vice-chairs being occupied by W. P. Brookes, Esq., and Mr. Owen, the president of the Working Men's Institute. About sixty-four gentlemen were present.

WIGAN MECHANICS' INSTITUTE.—The fifth annual soirée of this Institution was held on Wednesday evening, October 27th, the Right Hon. E. Cardwell, M.P., presiding. Amongst those present were, Henry Woods, Esq., M.P. for the borough; Colonel the Hon. James Lindsay; N. Macleod, Esq., Secretary of the Department of Science and Art; R. Rumney, Esq., Manchester; J. Acton, Esq.; J. Ingram, Esq.; Edmund Clarke, Esq.; W. Peace, Esq.; M. Peace, Esq.; Rev. D. Blythe; R. Laing, Esq., &c., &c. Mr. Joseph Ingram, chairman of the directors, read the report. The number of members at present on the books are:—One member at £10; one at £5; one at £3 3s.; 114 at £1 1s.; 216 at 10s.; ten at 5s.; eighteen nominated by the donors of coal; in all 361, or 66 more than in the corresponding quarter of 1856. The directors desire to notice one circumstance which is very injurious to the pecuniary interests of the Institution. During the summer months, while all the expenses are as great as during the winter ones, many of the members cease to subscribe, so that the deficiency, made up of sums trifling to the individuals, is large in the aggregate, and causes a serious loss. Considerable improvements have been made in the accommodation, which are likely to increase the comforts of members. All the books in the library have been classified and arranged in a more convenient form, and the sum of £5, presented by the Right Hon. Lord Lindsay, and of £10, presented by F. S. Powell, Esq., have been expended in the purchase of 120 volumes. There are now 2,100 volumes in the library. The following is an account of the books, arranged according to their classes, which have been taken out since the re-opening of the library, on the 19th of July, to the 30th of Sep-

tember—a period of two months and a half:—of class A, or novels, romances, and tales, 869; of class B, or dictionaries and encyclopædias, 11; of class C, or fine arts, 21; of class D, or mathematics, &c., 12; of class E, or miscellaneous works, 110; of class F, or natural and experimental philosophy, 69; of class G, or natural history, 76; of class H, or biography, history, and geography, 239; of class I, or periodicals, reviews, and magazines, 201; of class J, or poetical works, 20; of class K, or voyages, travels and adventures, 168; of class P, or parliamentary reports, 4; in all, 1,850 volumes, which, added to the 3,023 volumes given out from the first of January to the 29th of May, at which time the library was closed for a month, gives a total of 4,873 volumes—being at the rate of 650 volumes per month; and when compared with the issue of 1856, there is in favour of the present year an increase of no less than 1215—*i.e.*, an average increase of 136 per month. The present number of pupils in the elementary classes is 70, the average attendance being 48. The mathematical class is still conducted with the same success as in former years. Another class for geometry has lately been opened, under the superintendence of one of the directors. The French classes are also in operation. Other necessary classes will be formed as soon as there seems a prospect of a sufficient attendance to reward the gratuitous services of those who are now willing and competent to undertake them. In order to promote the success of these classes, F. S. Powell, Esq., M.P., presented prizes to the amount of £10 to the successful candidates at the annual examination, and he has promised to do the same this year. Three lectures have been given this year; one by F. S. Powell, Esq., M.P., entitled "Recollections of a recent Visit to Rome and Naples; F. Hudson, Esq., of Manchester, delivered another on "The Chemistry of our Homes," R. Laing, Esq., meeting the expenses connected with the supply of the lecturer; Mr. Birkenhead delivered a third, upon "What we eat, and Why we eat." The financial position of the Institute is not very satisfactory. Many extra expenses, have, however been incurred, and notwithstanding its present financial position, the directors feel confident that the Institution is progressing favourably. Maskell Peace, Esq., read the report of the Mining and Mechanical School. It stated that on the 2nd of August last, a free lecture was given by Mr. Birkenhead, when the opening of the school was publicly announced. A valuable collection of chemical apparatus and mechanical models was ordered by the committee, and the school was opened on the 9th of August. The classes have regularly met since then, on Monday, Wednesday, and Friday evenings, for two hours each night, and the subjects taught have been chemistry, mechanics, and geology. The average weekly attendance has been fifteen. The finances of the school are in good condition. The meeting was afterwards addressed, at considerable length, by the chairman, as well as by R. Rumney, Esq., of Manchester, Henry Woods, Esq., M.P., M. Macleod, Esq., and other gentlemen, and separated after the usual compliments to the chairman.

MEETINGS FOR THE ENSUING WEEK.

MON.....Medical, 8.

TUES. ...Statistical, 8. 1. Mr. FOX, "On the Vital Statistics of the Society of Friends.', 2. Mr. Danson, "On a Method of Relieving the Density of Town Population."
Civil Engineers, 8. Discussion upon Mr. Scott's paper, "Description of a Breakwater at the Port of Blyth, &c."
Pathological, 8.

WED. ...London Institution, 3. Mr. T. Rymer Jones, "On the Natural History of the Vertebrate Division of the Animal Kingdom."
Society of Arts, 8. Mr. Leonard Wray, "On Cotton Culture and Preparation in the United States."
Microscopical, 8.

THURS....London Inst., 7. Dr. S. Frankland, "On the Air and Water of Towns."
Numismatic, 7.
Antiquaries, 8.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, December* 10, 1858.]

Dated 30th August, 1858.

1956. F. Brignoles, 58, Torrington-square—Imp. in apparatus for the disinfection and rectification of bad tasted alcohols, by the separation of the essential oils from the alcoholic exhalations (A com.)

Dated 9th November, 1858.

2502. E. E. Allen, Brompton-row—Improved machinery or apparatuses for working the propellers of vessels.

Dated 12th November, 1858.

2540. J. G. Martien, Ampthill-square—Imp. in the manufacture of iron, and in the apparatus employed in such manufacture.

Dated 19th November, 1858.

2610. P, Marchand, E. Marchand, and J. Marchand, Dunkirk, France—A new process for refining lamp oil.
2612. W. S. Hayward, Wittenham House, Abingdon—Imp. in the manufacture of a glutinous and viscous substance or dextrine, to be used in the manufacture of paper, and in dressing textile fabrics, by which greater tenaciousness, smoothness of surface, and body is obtained.
2614. S. C. Lecch and J. Leech, Manchester—Certain imp. in the construction of 'self-acting temples,' to be employed in looms for weaving.
2616. W. Hancock, Upper Chadwell-street—Imp. in the manufacture of electric telegraph wires and cables.
2618. H. H. Henson, 38, Parliament-street—Imp. in waterproofing fabrics or materials.
2620. E. A. Pontifex, Shoe-lane—Imp. in external surface condensers.
2622. W. Clark, 53, Chancery-lane—Imp. in purifying natural phosphates of lime. (A com.)
2624. J. E. F. Luedeke, Chipping Norton, Oxfordshire—Imp. in motive power engines.
2628. J. Easton, sen., and C. E. Amos, The Grove, Southwark—Improved apparatus applicable to drains, sewers, and watercourses, for the purpose of removing extraneous solid matters therefrom.
2630. T. S. Cressey, High-street, Homerton—Imp. in machinery used in the manufacture of casks.

Dated 20th November, 1858.

2632. J. Wadsworth, Salford—Imp. in gas burners, and in the means or methods of and in apparatus for moderating or retarding, regulating, or governing the flow and pressure of gas used for purposes of illumination, and in street lamps or lanterns for shielding flame from the action of wind and rain.
2634. D. Rowan, and S. Robertson, Greenock—Imp. in steam-engines.
2636. C. Tomlinson, Worcester-street, Wolverhampton—Imp. in stop taps or valves.
2640. H. Jordan, Liverpool—Imp. applicable to navigable vessels.
2642. L. Percivall, Birmingham, and J. Houghton, Edgbaston, Warwickshire—Imp. in attaching knobs of glass, china, and earthenware, to the spindles of locks and latches, and to doors, drawers, and other articles.
2644. H. Swan, 5, Bishopgate without—Imp. in stereoscopes and other optical instruments, and in stands or supports for stereoscopes.
2646. H. Gardiner, New York, U.S.—Imp. in the compound axle hub and wheel for railroad cars.

Dated 22nd November, 1858.

2648. R. Nelson, New York, U.S.—Imp. in apparatus for raising and lifting water and other liquids.
2650. S. W. Johnson and J. Varley, Peterborough—Imp. in pressure and vacuum gauges.
2652. E. H. Bentall, Heybridge, Essex—An imp. in the construction of turnip cutters.

Dated 23rd November, 1858.

2654. W. Ralston, Manchester—Imp. in embossing and finishing woven fabrics, and in the machinery or apparatus employed therein.
2655. W. H. Dawes, Bromford Iron Works, West Bromwich, Staffordshire—An imp. in forge hammers, and in the anvils used with forge hammers and squeezers.
2656. W. Gorman, Glasgow—Imp. in furnaces, and in the combustion of fuel, and in apparatus connected therewith.
2657. J. Fairweather, Dundee, N.B.—Imp. in weaving bags, sacks, and other tubular fabrics.
2658. N. F. Boréiko de Chodzko, Paris—A smoke preventing apparatus.
2659. V. Newton, 66, Chancery-lane—Imp. in retorts for generating illuminating gas. (A com.)
2660. V. Newton, 66, Chancery-lane—Improved machinery for sweeping floors. (A com.)
2661. W. Warne, J. A. Jaques, and J. A. Fanshawe, Tottenham—An improved fabric, applicable for covering floors and wa[illegible] and for other analogous purposes.

Dated 24th November, 1858.

2662. R. H. Hughes, Hatton-garden—Imp. in means or apparatus employed when lighting by gas.
2663. R. A. Brooman, 166, Fleet-street—An imp. in cigar cases. (A com.)
2664. Sir Charles Shaw, Old Cavendish-street—Imp. in the construction of ball and bullet proof shields or mantlets.
2665. W. E. Newton, 66, Chancery-lane—Imp. in mills for grinding corn. (A com.)
2666. A. V. Newton, 66, Chancery-lane—Improved machinery for making bolts and rivets. (A com.)
2657. R. H. Hess, Islington—A new manufacture of articles, parts of articles, parts of machinery, surfaces, and ornamental works from talc and other silicates of magnesia.
2668. C. Peterson, Lowcliffe-lodge, Isle of Wight—Imp. in the manufacture of paper cartridges, and in paper applicable for waterproof purposes.
2669. J. S. Nibbs, Aston, Warwickshire—Imp. in lighting, heating, and ventilating.
2670. J. H. Johnson, 47, Lincoln's-inn-fields—Imp. in the employment of electricity as a motive power. (A com.)

Dated 25th November, 1858.

2671. C. E. Amos, the Grove, Southwark—Improved apparatus for raising and supporting ships or vessels while undergoing repair, which apparatus is also applicable for facilitating the passage of ships or vessels over bars, sandbanks, or in shallow waters.
2672. F. C. Calvert and C. Lowe, Manchester—Imp. in the manufacture of size.
2673. H. Eastwood, Elland, near Halifax—Imp. in purifying gas for illuminating purposes.
2674. R. Bodmer, 2, Thavies-inn, Holborn—Imp. in valves for regulating the supply of steam. (A com.)
2676. C. F. Vasserot, 45, Essex-street, Strand—An improved petticoat and bustle. (A com.)
2677. J. Nuttall, Old Accrington, G. Riding, Clayton-le-Moors, and W. Coulthurst, Old Accrington—Imp. in sizes for sizeing cotton linen or other warps or yarns for weaving.
2678. F. H. Maberly, Stowmarket, Suffolk—Imp. in candlesticks.
2679. C. Parker, Dundee—Imp. in looms for weaving.
2680. F. Loos, Mercer-street, Long-acre—Imp. in gas regulators.
2681. C. Mather, Salford—An improved steam trap or apparatus for allowing the escape of water and air from pipes, vessels, or chambers heated by steam.
2682. W. Burton, Bethnal-green—Imp. in preparing colouring matter for dyeing.

Dated 26th November, 1858.

2683. J. Luis, 1B, Welbeck-street, Cavendish-square—A new sort of drawers or trousers for ladies or children. (A com.)
2685. E. Dixon and J. Fisher, Wolverhampton—An imp. in the manufacture of welded iron tubes.
2687. M. Meyers, 9, Great Alie-street, Goodman's-fields—Imp. in parasols.
2689. G. Richardson, 1, New Broad-street—Imp. in machinery or apparatus for pressing bales of goods. (A com.)
2691. J. B. Booth, Preston—Imp. in machinery or apparatus for preparing, spinning, doubling, and winding cotton and other fibrous materials.
2693. P. Griffiths and J. Brennand, Burnley, Lancashire—Imp. in lubricators for introducing lubricating matter into steam cylinders and other chambers or parts under pressure.

Dated 27th November, 1858.

2695. J. Tangye, Birmingham—An imp. in hydraulic presses.
2697. G. Collier, Halifax—Imp. in means or apparatus employed in weaving.
2699. F. C. Kinnear, Hoxton, and D. Posener, Windmill-street, Haymarket—Imp. in the means of preserving life and property in navigation.
2701. C. Burrell, Thetford—Imp. in traction engines and carriages.
2703. W. Tillie, Londonderry, Ireland—An imp. in the manufacture of shirts and shirt fronts.
2705. H. Gerner, 2, Garway-road, Bayswater—Imp. in the mode of and apparatus for manufacturing gas for illumination and heating.

Dated 29th November, 1858.

2707. G. Oates, Gatefield Works, Sheffield—Imp. in the manufacture of scissors. (A com.)
2709. F. S. Perrare-Michal, 20, Rue de la Chaussée d'Antin, Paris—Imp. in the manufacture of bridles (without bits and without curb-chains) for riding, driving, or otherwise conducting horses.
2711. W. E. Newton, 66, Chancery-lane—Improved expansion or cut-off gear, for steam-engines. (A com.)
2713. W. Parsons, Bittern, near Southampton—Doing away with the smell arising from the melting fat, tallow, &c., and also for an improvement in stirring and straining the same.
2715. J. Lea and W. A. Sherring, Cecil-court, St. Martin's-lane—Imp. in the treatment of vegetable fibres for the manufacture of paper, spinning, and other purposes.
2717. J. H. Johnson, 47, Lincoln's-inn-fields, Imp. in locomotive engines. (A com.)
2719. L. A. Normandy, jun., 67, Judd-street, Brunswick-square—Imp. in manufacturing files. (A com.)
2721. J. Gresham, Hull—Imp. in apparatus for preserving ship's papers, and other papers and writings, in case of the loss of, or accident to, a ship whilst at sea.
2723. D. Evans, Chobham cottages, New Town, Stratford, and G. Jones, Charlotte-place, Upper Kennington-lane—Imp. in pumps and water gauges.

Dated 30th November, 1858.

2725, J. Luis, 1B, Welbeck-street, Cavendish-square—A new railroad with continued supports splintered together without any wood being used. (A com.)
2727. A Marks, London-wall—Imp. in the manufacture of braided articles.
2729. J. Thow, and T. Hall, Preston—Preventing the fusion of the fire-bars in locomotive or other furnaces.
2731. G. Boccius, Totnes, Devonshire—Imp. in the construction of furnaces.
2733. J. Colyer, Leman-street—Imp. in machinery and apparatus for cutting and shaping staves and other parts of casks.

Dated December 1st, 1858.

2735. A. Stenger, 4, Gresham-street—Imp. in the manufacture of cravats, braces, belts, and waistbands.
2737. J. Loach and J. Cox, Birmingham—Certain imp. in ornamenting the surfaces of japanned goods, and which said imp. are also applicable to the ornamenting of certain other surfaces.
2799. T. P. Pursglove, Battersea—An improved pressure gauge for steam, gas, or other fluids.
2741. C. F. Vasserot, 45, Essex-street, Strand—An apparatus for printing with different colours thread, to be applied to tha manufacture of textile fabrics. (A com.)
2743. E. Viney, Cornhill—An imp. in the construction of portmanteaus, desks, dressing-cases, despatch-boxes, and other like articles.
2745. F. Warner, Jewin-street, J. Derbyshire, Longton, and A. Mann, Little Britain—An imp. in the manufacture of cocks or taps.
2747. H. Bessemer, 4, Queen-street-place, New Cannon-street—Imp. in railway and other wheels and wheel tyres.
2749. A. E. Davis, 1, Pulboro'-place, Harleyford-road, Vauxhall, and R. Wright, 28, Grosvenor-park, Camberwell—Imp. in the manufacture of colouring matter for spirits and other liquids.
2751. L. Bissell, New York, U.S.—Imp. in trucks for locomotive engines.
2753. E. L. Benzon, Sheffield—The manufacture of useful alloys of aluminium. (A com.)

INVENTION WITH COMPLETE SPECIFICATIONS FILED.

2809. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—An improved apparatus for ascertaining and registering the work of certain kinds of lever balances. (A com.)—7th December, 1858.

WEEKLY LIST OF PATENTS SEALED.

[*From Gazette, Dec.* 10, 1858.]

December 10th.

1325. J. Gemmell.
1353. W. P. Wilkins.
1391. H. Becu.
1433. C. Nightingale.
1439. P. M. Crane.
1477. W. Clark.
1486. E. Lord.
1488. A. V. Newton.
1911. M. R. Pilon.
2177. L. Cecconi.
2268. W. E. Newton.
2284. J. Braby & J. Braby, jun.

[*From Gazette, Dec.* 14, 1857.]

December 14th.

1342. H. J. Daniell.
1344. G. Neall.
1348. C. C. J. Guffroy.
1354. Sir F. C. Knowles.
1355. H. S. Warner.
1361. C. W. Lancaster.
1363. J. J. Cregeen.
1364. J. H. Dickson.
1419. R. Armstrong.
1574. G. Buchanan.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

[*From Gazette, Dec.* 10, 1858.]

December 6th.

2768. H. Bessemer.
2781. J. Cocker.
2785. P. A. le Comte de Fontainemoreau.

December 8th.

2796. J. Cliff.

[*From Gazette, Dec.* 14, 1858.]

December 9th.

2792. J. E. De Malbec.
2847. J. L. Jeffree.

December 10th.

2797. J. H. Johnson.
2820. J. H. Johnson.
2821. J. H. Johnson.